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MACHINERY

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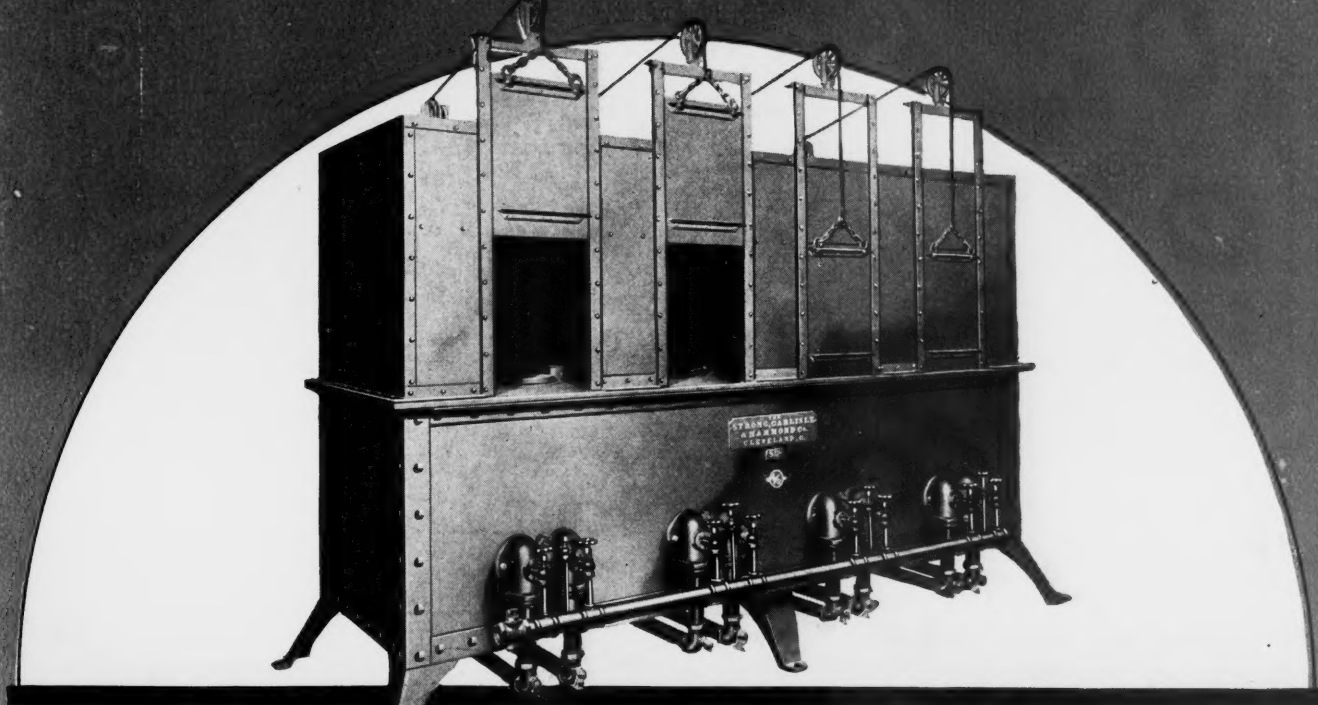

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CONTENTS OF THIS NUMBER

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The Editor's Monthly Talk

GENERAL industrial prosperity in the United States is impossible unless the railroads are in a position to handle the traffic of the country efficiently. The railroads are the arteries of this great industrial country, and unless they can function adequately no other activities, commercial or agricultural, can prosper.

The vital factors in the efficient operation of the railroads are capable management, efficient personnel and modern equipment. The traffic management of American railroads, on the whole, has proved its ability. The personnel is efficient and capable, unless through ill-considered rules governing working conditions, its initiative is decreased and its ambition deadened. The equipment, generally speaking, is away below par and has been deteriorating for years. Efficiency in the repair of locomotives and cars is therefore of vital importance, and for this, up-to-date machine tool equipment is a necessity in every railroad repair shop. Costs must be reduced, and the railroad equipment must render full service.

The series beginning in April MACHINERY on "Railway Machine Shop Practice" deals with the necessary factors for attaining railroad shop efficiency. The first article shows the methods used for repairing locomotives in the shops of three important railroad systems.

Satisfactory shop equipment, however, is not the only requirement. It is also necessary for ambitious and efficient workers to see encouraging prospects ahead. Recognition of merit and the promise of early promotion are necessary factors in the railway industry. The so-called "National Railroad Labor Agreement" can hardly be said to stimulate efficiency and ambition among the men in the shops. It ties the individual down, whether he is working at a simple task, or is a foreman, or a higher executive. Some of the objectionable rules in the agreement that the railroads are now trying to have modified are pointed out in an article on "The National Railroad Labor Agreement." Everyone interested in the prosperity of the railroads—and every man engaged in the industries is affected, for his own prosperity depends upon it—will be interested in the definite information upon the National Agreement contained in this article.

Management Problems

A highly developed system for controlling production based upon the principles of the well-known Taylor System is employed by the H. H. Franklin Mfg. Co., Syracuse, N. Y., and applied to their entire automobile plant. This system has been carefully worked out and thoroughly tried for several years. It insures that production of the numerous parts of the Franklin car will be sufficient at all times to take care of the demand of the assembling departments; and that production of the different lots of parts will be started and completed on predetermined dates, based not only upon the total number of cars required in a given time, but also upon the relative order of assembling the various units entering in the construction of the complete car.

The details of this system, described in the article "Central Control System in the Franklin Plant" in the April number, will prove of interest to every manager, production engineer, superintendent or other shop executive upon whom the responsibility for production rests.

Modern Inspection Methods

An interesting series of articles beginning in May MACHINERY, will cover modern inspection methods, and will describe the principles of inspection, the organization of modern inspection departments and the maintenance of the gaging equipment. There will be included a description of modern gaging fixtures and methods with ample illustrations. These articles are based upon the successful practice of one of the most highly organized plants for interchangeable manufacture and quantity production in this country—the Delco plant in Dayton, Ohio—but the fundamental principles may be applied with but slight modifications to small as well as large shops.

One of the interesting points made in this series is that inspection should deal not only with the finished product ready to leave the plant, but, to be completely effective, should concern itself with everything that enters the plant as well. The castings, the steel, the taps and reamers, the machine tools, the micrometers and other equipment entering the plant for use in production should be as carefully inspected upon arrival as is the finished product that leaves the plant.

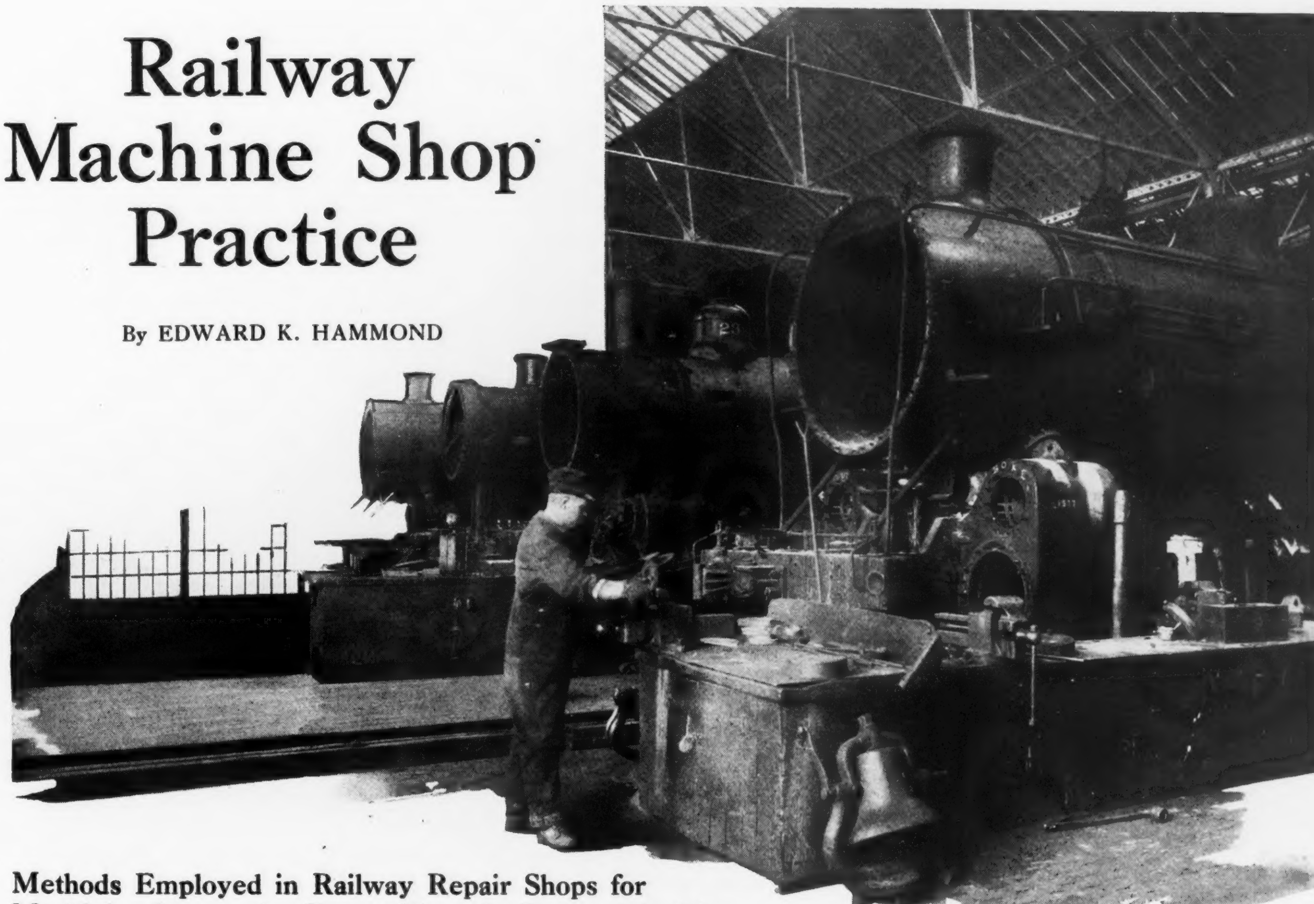
Efficiency in Assembling Work

Years ago the mechanical world became greatly interested in the methods for assembling automobiles employed at the Ford plant in Detroit, where the progressive assembling method was installed and developed well-nigh to perfection by employing the conveyor principle. Since that time, this method has been installed in a number of plants and for a great variety of products, some notable examples being in the assembling of phonograph motors, gear-cases, stoves and sewing machines. An article in May MACHINERY will deal with progressive assembly conveyors, explaining the principles involved and the advantages to be gained whenever the product lends itself to their use.

Among other articles of interest to the wide circle of MACHINERY readers in the May number may be mentioned "Dynamic Balancing Stand," "Products of a Modern Tool-Room," "Car and Car-and-Ball Furnaces," and "Machining Motor Pistons."

Railway Machine Shop Practice

By EDWARD K. HAMMOND



Methods Employed in Railway Repair Shops for Machining Locomotive Parts—First of a Series of Articles

ABLE management, efficient workmen, and modern machinery are the vital factors in successfully operating a railway machine shop. The repairing and overhauling of locomotives and cars bears a closer resemblance to the work done in jobbing shops than to the work of manufacturing plants, because, in even the largest railway shops, there is a relatively small number of duplicate parts to be machined. Hence a mere machine operator who may be as efficient as the experienced machinist on repetition work in a manufacturing plant, is likely to be of less value in the railroad shop where each job differs from the last, and where a man is depended upon to put into each piece of work which he handles the dexterity and knowledge that have been acquired through years of experience.

To get the best results from the type of men needed for repairing locomotives and cars, it is necessary to foster the idea that each man in the shop is depended upon "to do his bit" in helping to keep the railroad's rolling stock out on the tracks. This is one of the problems of management that enter into the operation of a railway machine shop. The capable superintendent or foreman has learned to give a merited word of encouragement which causes each mechanic in the shop to feel that it is known when he does a really good job. Equally important with efficient men is the provision of modern shop equipment, for without good tools at his disposal the workman is unable to produce satisfactory results.

In the operation of railroad equipment, just as in the case of machine tools in a shop, or any other similar proposition, it is a point of vital importance to reduce non-productive time to a minimum; and with railroad cars and locomotives, one of the serious items of idle time is covered by those periods during which equipment is in the shop for repairs. In the present series of articles, methods that have proved to be successful in doing repair work on railway rolling stock will be described.

Efficiency in the repairing of locomotives and cars is a matter of vital importance both to the men who are responsible for railroad operation and to those who use the railroads either for travel or for the shipping of merchandise. Able shop management, thorough mechanics, and proper shop equipment are necessary factors for obtaining such efficiency. The present article deals with methods used in the shops of three important railroad systems for the making of repairs on locomotives. These methods have been thoroughly tried out and have proved to give satisfactory results both as regards the quality of the workmanship and the time required.

Slotting Locomotive Frames

Men who have had experience in the building or repairing of railway locomotives know that the upper part of the structure is supported by two parallel frames which extend for practically the full length of the engine at either side. These members are made of steel, and in the process of machining it is necessary to finish the so-called jaws in which the driving-boxes are held by the shoes and wedges; also, it is required to machine the front ends which support the engine cylinders and to perform various other machin-

ing operations that differ according to the type of engine of which the two frame members form a part. Productive efficiency is always an important matter, but in the handling of railroad shop work it is of unusual importance, because the urgent demand for equipment on the railroads makes it imperative that an engine which is sent in to the shop for repairs shall be put back into service at the earliest possible moment.

In Fig. 1 is shown the method of machining engine frames, which is employed in the Burnside shops of the Illinois Central Railroad Co., in Chicago, Ill. Many time- and labor-saving methods are employed in this plant, of which the present is a typical example. It will be seen that four frames are stacked on the table of a duplex traveling-head slotter built by William Sellers & Co., Inc., of Philadelphia, Pa. This slotter has a table of ample length to hold the longest engine frames, and the heads of the machine, which face each other, can be moved along the bed so that the cutting tools carried by the rams may be brought into the correct position to reach any part of the work on which a machining operation is required.

In setting up this job, the first frame is blocked up sufficiently to afford enough clearance on the under side to allow the tools to plane right down to the bottom of the work. The design of this slotter has been developed in such a way that provision is made for obtaining angular settings for planing the openings between the jaws to make the required adjustments for the driving-box fits; and all straight surfaces running transverse or parallel to the sides of the slotter table can be finished by the regular feed movements provided for that purpose. Four frames can be completed on this machine without requiring any change in the setting of the work; and as a result, the job is handled with maximum efficiency.

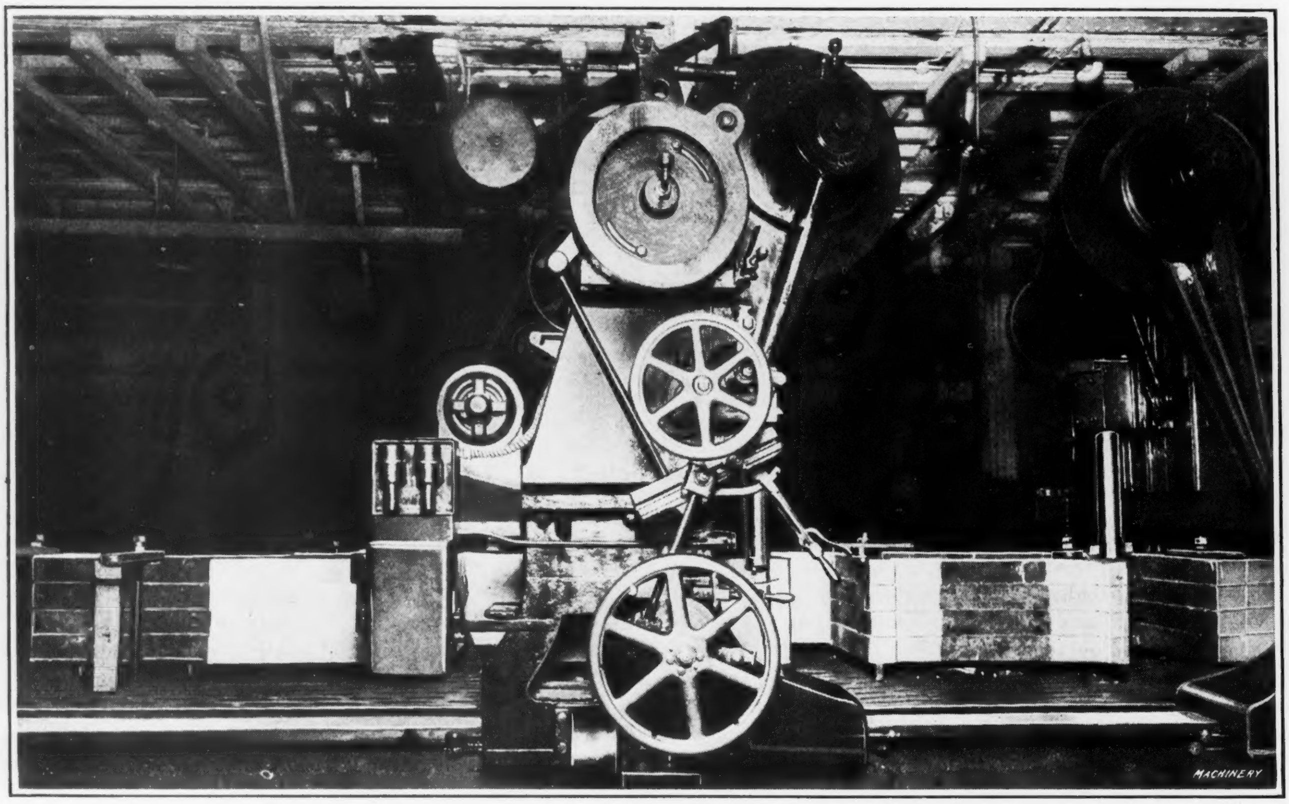


Fig. 1. Duplex Traveling-head Slotter that provides for simultaneously machining a Stack of Four Locomotive Frames

Drilling Operations on Engine Frames

After the frames have been planed on the slotter illustrated in Fig. 1, it is necessary to drill a large number of holes in them. Special multiple-spindle drilling machines are built for this purpose, and such equipments give very efficient results. However, for a shop devoting the greater part of its attention to the maintenance of engines (although a few engines are built as more or less of a side line), it will be evident that there is not enough frame drilling to be done to keep a single-purpose drilling machine employed for a sufficient part of its time to earn a satisfactory rate on the investment. For that reason, the management of the Burnside shops decided to do this work on a battery of four radial drilling machines built by the Cincinnati Bickford Tool Co., of Cincinnati, Ohio.

In working out the design of supplementary equipment for use with these machines, a special auxiliary table was provided for supporting the work in either a horizontal or a vertical position, so that the drills carried by the radial heads would be able to reach any desired position on the engine frames. This group of machines is shown in operation in Fig. 2; and there is a substantial advantage accruing from the fact that when there are no frames to be drilled, each of these radial drilling machines is capable of operating at its full efficiency on other work.

Attention is called to the fact that for the drilling of holes at the top or bottom of the frames, two frames are set up together on the vertical face of the table, as experience has shown that when handled in this way, the work can be completed in less time. For those types of engine frames which are frequently drilled in this shop, jigs have been provided, which are made of sheet steel with the bushings pressed into place. These jigs facilitate the performance of drilling operations and assure accurate location of all of the drilled holes; they also eliminate the time required to lay out the work preparatory to drilling.

Boring Engine Cylinder Castings

In the machining of most large castings, laying out of the work becomes a matter of exceptional importance, because of the possibility of cores slightly shifting their positions or of the molds settling in such a way that the castings will not be of exactly the required form. Errors resulting from such causes are guarded against through having the work carefully laid out to protect against contingencies of the kind which have been mentioned. In handling such work preparatory to the machining of locomotive cyl-

inder castings at the Burnside shops, the first step consists of marking with chalk over those surfaces on which the different fixed points are to be machined, and then scribing the outlines of the valve chamber, the cylindrical segmental seat for the smokebox, etc.

With the work laid out in this manner, the casting is set up on a horizontal boring machine built by the Niles Tool Works Co., in Hamilton, Ohio. In setting up one of these castings, use is made of the outlines which have been laid out on the work to assure obtaining an accurate location, and when this has been done the cylinder is bored and faced. On the machine used for this purpose there is a rotary cutter-head that slides on a hollow bar and is fed through the work by means of a screw contained inside of the bar. After the boring operation has been completed, a facing head is mounted on the bar at each end of the casting. These heads are secured to the bar and furnished with cutter bits carried by cross-slides. Each of these cross-slides has a screw with a star feed at its end, which comes into contact with a stop on the frame of the boring machine at the conclusion of each revolution. In this way, the cutter bit is fed across the face at each end of the cylinder and provides for finishing it to the required length and accuracy.

Subsequent Machining Operations on Cylinder Castings

After the cylinder has been bored and faced, the casting is sent to a traveling-head planer built by the Morton Mfg. Co., of Muskegon Heights, Mich., which is employed for planing the connection between the two cylinder castings, for finishing the upper and lower frame slots, and for boring and facing the valve chamber. Fig. 3 shows a close-up view of this job while the planing of the connection is in process. As the work comes to this machine, advantage is taken of the fact that the cylinder has been accurately bored and it is used as a locating point. There is a three-jaw universal chuck on the machine, which enters the bored cylinder and engages the faced end of the casting, thus serving the double purpose of holding the work from a definite locating point and bringing it into a position where the planed surfaces will be perpendicular to the previously faced ends.

With a preliminary setting accomplished in this way, the next point is to level up the work, using the previously scribed lines as points of reference. This result is accomplished with a surface gage that is employed to measure from the planer table to the horizontal scribed line representing the level to which the connection fit *A* must be finished. This line is leveled up by testing its height from the table at opposite ends of the work, and regulating the jacks *B* and *C* that support the work as occasion demands. When the necessary adjustment has been made, the clamp *D* is tightened to hold the casting securely in this position, after which the planing of the connection can be started. For the machining operations on cylinder castings while held on this machine, two settings of the work are required. At the first setting, shown in Fig. 3, the connection and the lower frame slot are planed; and after this work has been completed, the casting is reset to provide for planing the upper frame slot. Then the cylinder boring-bar is set up on the machine to provide for boring and facing the valve chamber, which completes the sequence of operations.

Milling the Cross-head Key-slot in Piston-rods

The handicaps under which the railways have been operated during recent years have hindered the purchase of much of the equipment that is really needed for use in their shops. As a result, some rather clever special machines have been developed for the performance of certain minor operations on locomotive parts. A case in point is illustrated in Fig. 5, which shows a special machine developed for use in the Burnside shops of the Illinois Central Railroad Co. for milling the key-slot in a piston-rod, that provides for holding the cross-head in place. Reference to the illustration will make it apparent that this consists of a bed supporting a screw-operated carriage, to which the piston-rod is clamped in such a way that by turning a handwheel at the right-hand end of the machine, or by rotating the feed-screw by power, provision is made for feeding the work to the milling cutter.

Extending up from the bed there will be seen a framework that supports an air drill. This tool is employed to furnish the power feed by means of a belt running to a pulley carried on a vertical shaft *A* that drives a worm meshing with a worm-wheel at the end of the feed-screw. Also, it will be seen that the air drill is directly connected to the milling spindle *B*. After the job is set up on this machine, a hole is drilled through the piston-rod *C* in a

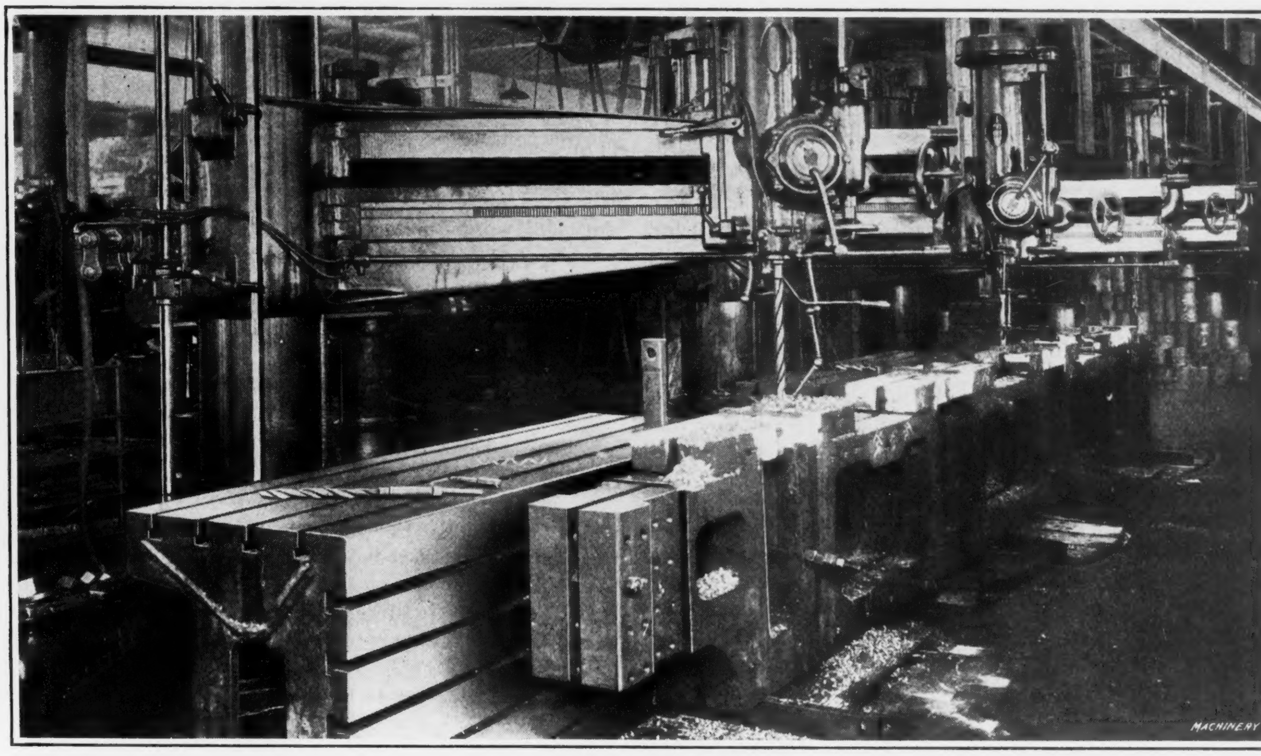


Fig. 2. Battery of Four Radial Drilling Machines equipped with a Special Table for Locomotive Frame Drilling and Miscellaneous Work

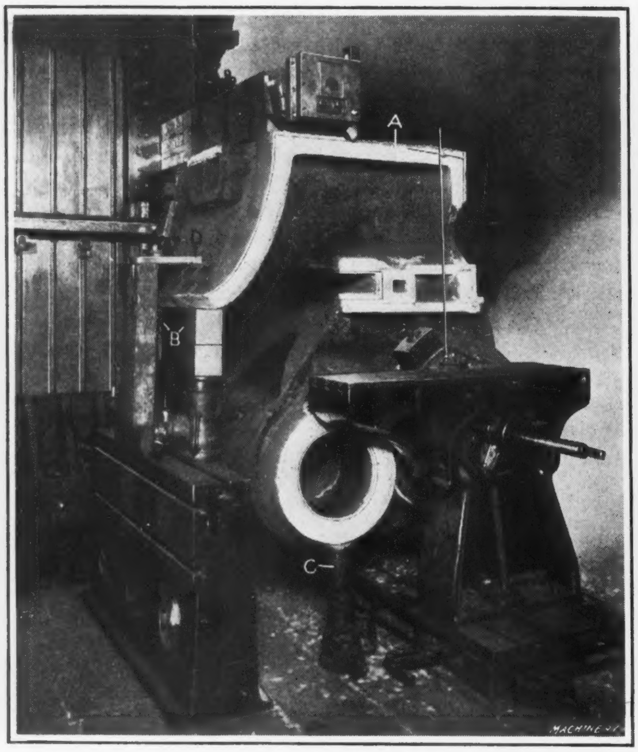


Fig. 3. Planing Connection Fit of Cylinder Casting on Draw-cut Planer, which also finishes Frame Slots, and bores Valve Chamber

Fig. 4. V-block Fixtures and Special Mandrel that are used for holding Cross-head while the Guide Bearings are being planed

position corresponding to one end of the key-slot, this being done by the air drill without any horizontal movement of the machine table. This hole receives the milling cutter. Then as the cutter is rotated by the air motor, the work is fed up to the cutter in the manner previously described. A machine of this type is inexpensive to build, and it has been found to give very satisfactory results in the performance of the operation for which it was designed. With this machine a key-slot measuring 3¾ by 1⅛ by 4½ inches can be cut in a forged steel rod in 1½ hours.

Method of Supporting Cross-heads for Planing the Guide Bearings

In the Chicago, Rock Island & Pacific Railway shops at Silvis, Ill., the method illustrated in Fig. 4 is employed for holding cross-heads while replaning the guide bearings after they have been rebabbitted. The arbor *A* by which the cross-head is carried is not the piston-rod, although it is of about the same diameter and length. One end of this arbor is machined to enter the fit in the cross-head, and it will be seen that at the opposite end the arbor is held in two V-blocks *B*, in which it is held down by straps. After a preliminary setting has been effected in this manner, the cross-head is squared up with the planer table and supported by means of clamps and straps of the usual kind. It is then ready for planing, this operation being accomplished by means of a broad-faced tool that is of sufficient width to shape out the whole guide bearing without requiring the planer head to be fed transversely across the work. In cutting a soft metal like babbitt, it will be apparent that a method of this kind can be employed without danger of damaging the tool.

Boring Wrist-pin Hole in the Cross-head

Fig. 6 illustrates a cross-head in which the wrist-pin bearing hole is being bored. This operation is performed on a vertical boring mill built by the Niles Tool Works Co., and used in the shops of the Chicago & Northwestern Railway Co. in Chicago, Ill. As the cross-heads come to this machine, they have been previously planed, so that there are finished faces which may be employed as locating points in setting up the work. It will be seen that an angle-plate fixture *A* is provided on the machine used for the performance of this operation; and there is a shoulder on the plate against which the work rests to assure accurately locating it under the boring spindle.

The operation to be performed consists of boring the two wrist-pin holes and of facing the inner sides of the bosses surrounding these holes, an offset tool being used for doing the latter part of the work. On the fixture, which is centrally located on the table, there is scribed a reference line that indicates the proper setting for the work on the fixture, in order to bring it into the correct position under the spindle of the boring machine. The same fixture is used for boring different sized

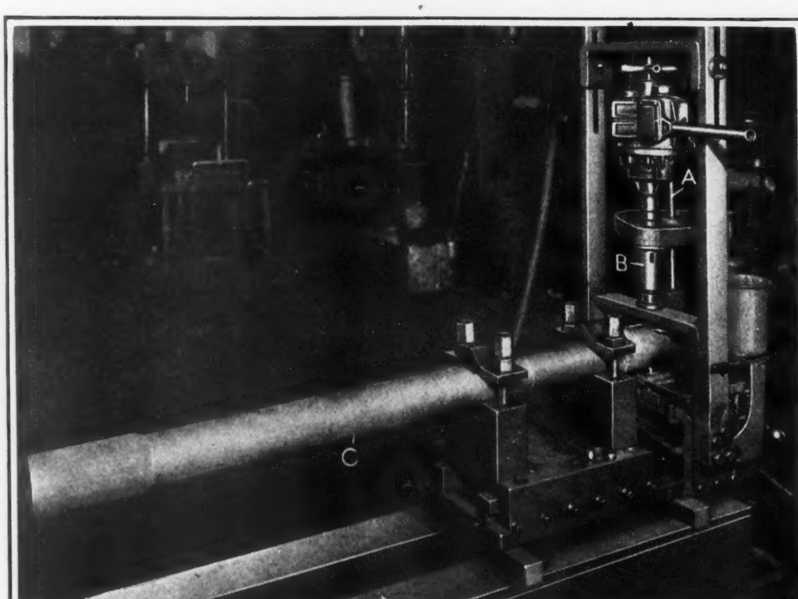


Fig. 5. Special Machine developed for Use in milling the Cross-head Key-slot in a Piston-rod

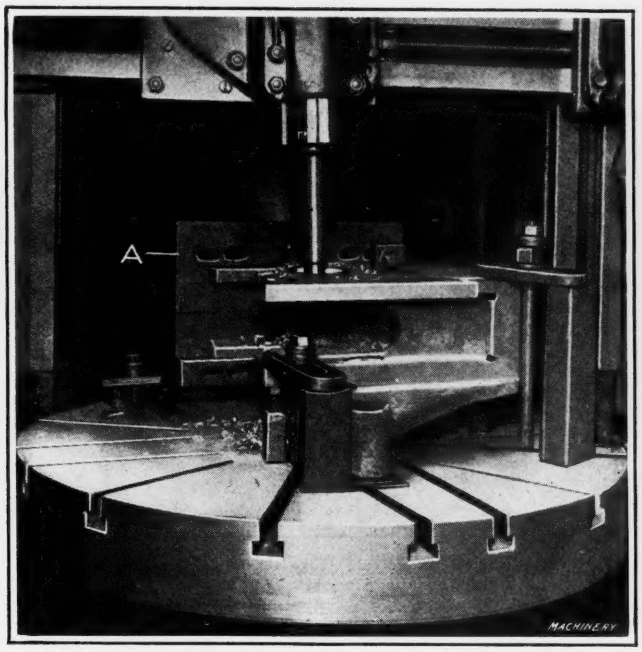


Fig. 6. Boring the Wrist-pin Hole in a Cross-head

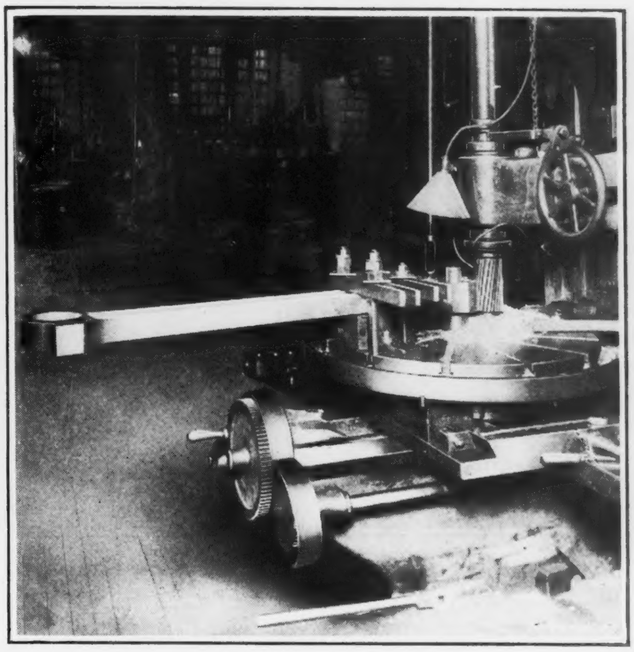


Fig. 7. Milling End of Side-rod to Required Form

cross-heads, and to accommodate various pieces of work a suitably placed locating line is scribed for use in locating each size of head, shims being employed between the work and the shoulder on the fixture to pack the cross-heads of different sizes so as to assure that they will be properly located and rigidly supported.

Planing Operation on Side-rods

Practice in the machining of main driving rods and side-rods naturally varies according to the shop in which the work is done. However, it is the average practice to either plane or mill the side faces of the enlarged section at each end of a rod, while the usual procedure is to mill the ends and the flute that is cut at each side. Later in this article, an explanation will be given of subsequent work on these members of a locomotive, including methods of boring the holes in the rods, pressing the bearing brasses into place, and rough- and finish-boring these brasses. However, we are at present interested in the finishing of straight flat surfaces on the rods, and in Fig. 8 there is shown a method used in the Chicago, Rock Island & Pacific Railway shops at Silvis, Ill., for planing the side faces of the heads of side-rods. Reference to the illustration will make it apparent that this is done on a planer built by the Niles-Bement-Pond Co., 111 Broadway, New York City, which is equipped with two opposed sets of housings and cross-rails, so that with two pieces of work set up on the planer table as illustrated, the tool carried by each head on each cross-rail can be employed for planing one end of each side-rod forging.

Obviously, if a planer of ordinary design were employed for doing this job, it would be necessary to short-stroke the work to provide for first planing one end of the forgings, and then to re-position the stroke of the planer table for operation at the opposite end.

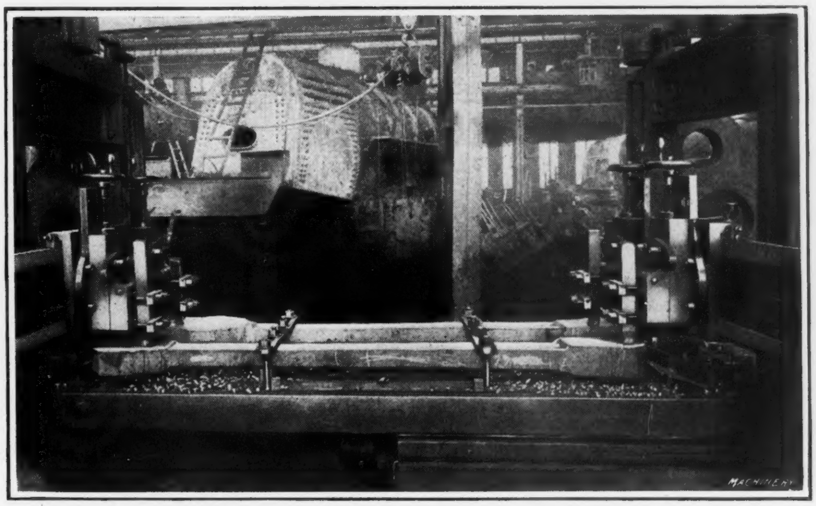


Fig. 8. Duplex Planer equipped with Two Sets of Housings, Cross-rails and Rail-heads for simultaneously planing Opposite Ends of Locomotive Side-rods

Otherwise, the procedure would be to handle the entire job at one continuous stroke of the table, which would result in loss of time during that period of each stroke for which the tool was "cutting air" during both the forward and return movements of the table between the two areas on the forgings which have to be planed. These troubles are avoided through using a double-head planer, because the table can be operated on a short stroke, and on the so-called forward stroke the work is being planed at one end, while at the return stroke it is being planed at the opposite end by the two tools on the cross-rail at the other end of the planer. From this description it will be apparent that the two sets of tools work alternately, so that there is no idle stroke and no loss of time by having the tool unemployed during a considerable part of the stroke. As a result, the use of a machine of this kind would appear to be the means of approximating the maximum degree of efficiency in the performance of this operation.

Milling the Ends of Side-rods

In the Chicago & Northwestern Railway Co.'s shops there are many locomotive side-rods to be machined, which are made with their ends of the form clearly shown in Fig. 7; and here there is also illustrated a method of milling the ends of these forgings to the required form. It will be seen that the contour of the work reverses the direction of curvature three times, and a very simple method is used for obtaining the desired result. The vertical-spindle milling machine is equipped with a plain cutter, the radius of curvature of which is made equal to the curvature of those sections of the end of the rod which join the part of the milled surface that is concentric with the bore of the bearing to the straight shoulder at each side. This milling cutter is operated on a machine

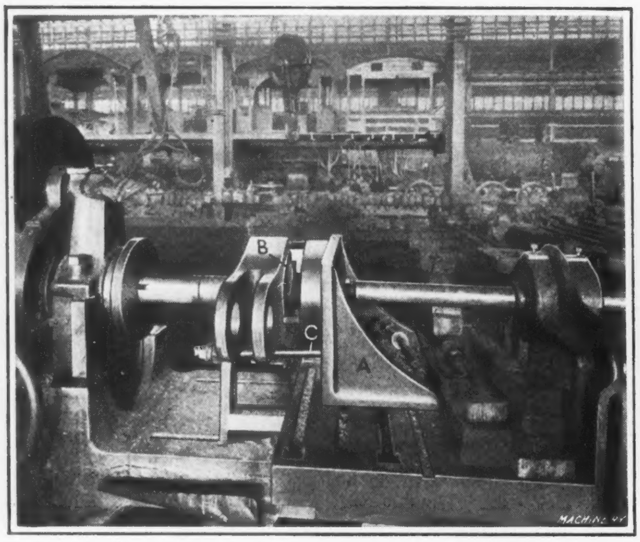


Fig. 9. Boring the Bearing Brass of a Locomotive Main Connection Side-rod

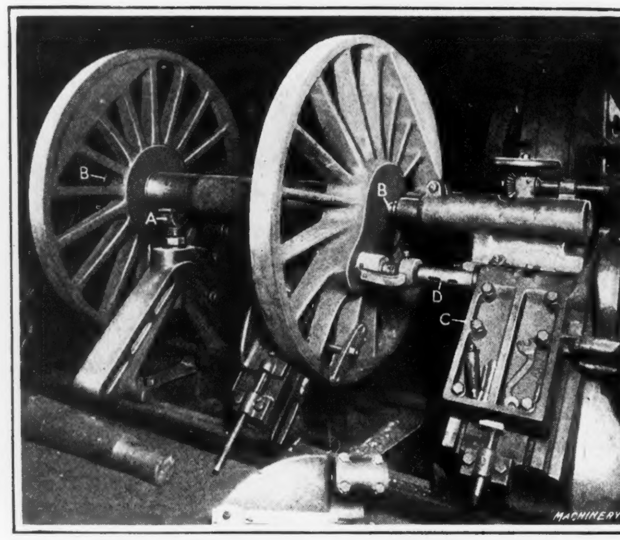


Fig. 10. Quartering Machine equipped for re-turning Crankpins of Driving Wheels

furnished with a table having longitudinal, transverse, and rotary feed movements.

The work is strapped on the table, with a pilot that is located at the center of table rotation fitting into the finish-bored bearing hole in the work. Care is taken to have the rod placed at right angles to the transverse feed movement. Then the cut is started by feeding the work transversely up to the milling cutter, to provide for finishing the flat shoulder and the radius that joins this shoulder to the portion of the contour that is concentric with the bearing. Having accomplished this result, the transverse feed movement of the table is stopped and the rotary feed movement substituted, in order to provide for swinging the work past the milling cutter to mill the concentric portion of the contour. When this has been finished, the transverse feed is once more brought into action, to complete the second shoulder on the rod. This method is then employed a second time to mill the opposite end to the same form, after resetting the work. The job is performed on a milling machine built by the Niles Tool Works Co.

Boring Bearing Brasses in Side-rods

In machining side-rods, the method of procedure is to bore the bearing hole at each end, after which the brass bushings are pressed into place and then rough- and finish-bored. Fig. 9 illustrates a horizontal boring machine built by the Niles Tool Works Co., which is used in the Silvis shops of the Chicago, Rock Island & Pacific Railway for the performance of this operation. So far as the actual boring operation is concerned, this job is of relatively small interest; but the tooling up of the machine is worthy of mention. It will be seen that an angle-plate *A* is provided on the boring mill table, with a three-jaw chuck carried by it to provide for gripping the shoulder *B* of the bronze bushing that extends out beyond the hole in the side-rod. This method enables the work to be located with the required degree of accuracy, and after a preliminary set-up has been obtained in this manner, the work is held back in the chuck by means of clamping bolts *C*, extending forward from the angle-plate, that are used in conjunction with suitable straps.

"Quartering" Locomotive Driving Wheels

It is the practice to have crankpins on locomotive driving wheels located at 90 degrees from each other. This makes it impossible for the pins to be stalled on dead centers and obviates the occurrence of interruptions of service from that cause. As the design of an engine is based upon a 90-degree spacing of the pins, it will be evident that efficient operation is dependent upon the maintenance of such an angular relationship. After a locomotive has been in service for a considerable period, it may be found that one or both of the pins have become slightly misplaced, either in regard to the stroke or the angular position.

When an engine is being overhauled or when a set of old driving wheels is being trued up, the location of the crankpins in relation to each other is tested with an equipment

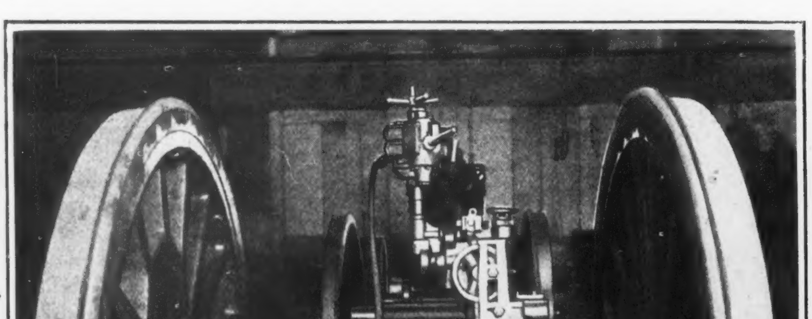


Fig. 11. Air-driven Keyseating Machine cutting Keyways for the Operating Eccentrics of the Stephenson Valve Gear

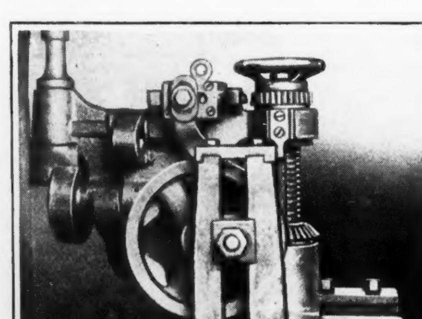


Fig. 12. Close-up View of Keyseating Machine shown in Fig. 11

known as a "quartering" machine, which is shown in operation in Fig. 10. This machine was built by the Niles-Bement-Pond Co., and it is shown in use in the Chicago & Northwestern Railway Co.'s shops. Reference to this illustration will make it apparent that the machine is furnished with two jacks *A*, by means of which the wheels are supported from the turned journals on the axle, after which centers *B* are entered into holes in the ends of the axle. The crankpins have also been accurately centered, and on the quartering machine there are two centers properly located for entering these holes. It will be evident that to adapt a machine of this kind for operation on wheel centers of various sizes, the auxiliary centers that engage the pins are mounted on slides *C* so that their positions may be adjusted for cranks of different lengths.

If the spacing of the crankpins is accurate, it will be evident that with centers *B* in place in the ends of the axle, the centers carried by the auxiliary spindles in slides *C* will enter the holes in the crankpins. However, it may be found that there is an error in this spacing, and such being the case, either of two methods of procedure may be followed in making the necessary correction. If the inaccuracy is not too great, a rotary cutter-head is mounted on one or both of the quartering machine spindles *D*, depending upon whether only one or both of the crankpins are misplaced, and the outside of the pin is returned to properly center it in relation to the pin carried by the opposite wheel. In cases where there is a greater amount of error to be corrected, the procedure is to send the wheel centers to a hydraulic press, which is used to force out the crankpins. Then, the wheels come back to the quartering machine to have the crankpin holes accurately rebored in the proper 90-degree relationship to each other, after which new pins are pressed into place. The reboring of the holes is done by boring tools carried by spindles *D*.

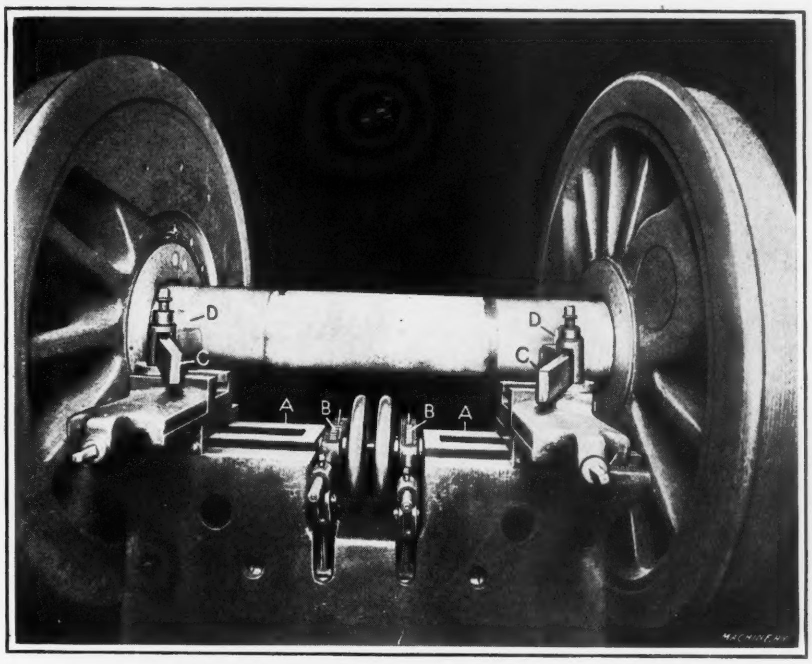


Fig. 13. Burnishing the Journals of a Locomotive Driving Axle after re-turning

Milling Keyseats for Eccentrics of Stephenson Valve Gears

Men who are familiar with locomotive design know that Stephenson valve gears are operated by eccentrics keyed to the driving axle at points just inside the journals. Figs. 11 and 12 illustrate a general view and a close-up view of a portable air-operated equipment built by Joseph T. Ryerson & Son, 16th and Rockwell Sts., Chicago, Ill., to provide for efficiently milling the keyseats in an axle, without requiring the wheel centers to be removed. It is shown in use in the Central of Georgia Railway Co.'s shops, engaged in milling the reverse eccentric keyway. This machine is operated by either an air drill or an electric motor, to which it is direct-connected by means of a tapered shank. Both the vertical and the horizontal feeds are entirely automatic, so that no attention is required beyond placing the tool in position. It is claimed that the use of this equipment avoids all possibility of the keyseat in the axle and the eccentric not corresponding, which may be the case when keyways are cut before the wheels are pressed on the axle.

For handling repair work where an old driving axle is retained, it frequently happens that the keyways in the eccentrics and the axle do not correspond, making it necessary to resort to the use of offset keys. This machine will recut the keyways in the axle to correspond to the slots in the eccentric. With the keyway cutting machine here illustrated, the valves can be set on the assembled driving-wheel center and the positions of the keyways transferred from the eccentrics to the axle, after which it is an easy matter to perform the keyseat milling operation. As compared with this procedure, consider the difference of time that would be involved if it were necessary to set up an "old man," in conjunction with which a hand- or an air-operated drill would be used to sink a hole at each end of the keyway, after which the intervening metal would be chipped out by hand or with a pneumatic chisel. It is claimed that with this Ryerson equipment, the time for cutting a keyway 1 by ½ by 6 inches in size should never exceed thirty-five minutes.

Re-turning Journals of Locomotive Axles

At a time when a locomotive is being completely overhauled, it may be found necessary to re-turn the journal bearings, and Fig. 13 illustrates the method of procedure of the Chicago & Northwestern Railway Co., in handling work of that kind. There are two points of interest in connection with this job: First, the design of the special machine on which the work is done; and, second, the method of obtaining the required finish. In setting up the work on this machine, attention is called to the fact that both the head- and tail-spindles are stationary, and the drive is accomplished by a pinion meshing with an internal gear at the back of the faceplate, which is loosely mounted on the headstock spindle, so that it is free to rotate and drive the work. The claim is made that with an equipment of this kind, the accuracy of alignment of the centers is maintained more perfectly, and as a result, a higher degree of precision is secured in turning the journal bearings.

This lathe was built from an old wheel lathe, and reference to Fig. 13 will show that the two tool-blocks are mounted on slides *A* that provide for traversing the tools along the journals which are to be turned. Inside the bed that carries these tool-blocks, there are two feed-screws which are turned by the ratchet and pawl mechanisms *B* that derive motion from a suitable arrangement of links connected to the same motor drive which delivers power to the main faceplate. A point of especial interest in connection with this job is the means used for securing the required degree of accuracy on the turned journal. This is done by first rough- and finish-turning, after which a burnishing operation is performed. It is done by the use of tools *C* that consist of holders, at the end of which ordinary steel burnishing rollers *D* are mounted in place of tool points. By applying a high pressure with these rollers and feeding them along the work just as an ordinary tool would be

handled, the rollers smooth down the slight inequalities left by the finish-turning tools and impart a finish to the work that gives it a high luster.

Repair shops maintained by the Chicago & Northwestern Railway Co., in Chicago, Ill., are depended upon to serve this company's entire system, in so far as the handling of important engine repairs is concerned. However, many minor repairs or the substitution of parts are made in various division shops provided for that purpose. For instance, consider the case of re-turning locomotive wheel tires. All such work is done in the main shops, but it would be an excessively expensive procedure to send an engine all of the way to Chicago to have the tires changed. Hence, to avoid such a procedure, the method is to have tires of different sizes in stock in the various division shops, so that when a change is required, the worn tires can be removed from the wheel centers and sent to Chicago to be re-turned, while tires held in reserve for that purpose are substituted on the engine.

Special Expanding Chuck for Re-turning Engine Wheel Tires

As the tires come to the shop, provision must be made for holding them in such a manner that the tread will be turned concentric with the bore; otherwise, the tire would be eccentric when shrunk on the wheel center, and thus be unsuitable for service. To avoid such a condition and still make it unnecessary to resort to the time-consuming and expensive method of shrinking the tires on the wheel centers for re-turning, a special expanding chucking device has been developed, that enables an accurate location of the tires to be obtained from the bore. This device consists of a pair of wheel centers which are of a slightly smaller diameter than the bore of the tires to be turned.

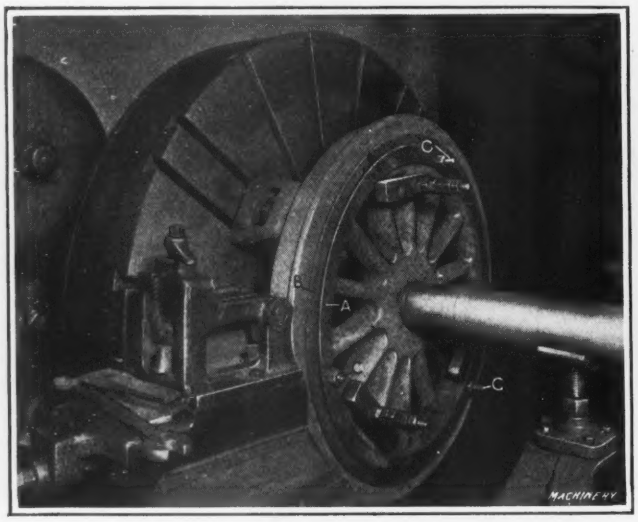


Fig. 14. Close-up View of Special Expanding Arbor used for re-turning Locomotive Wheel Tires

Between each wheel and its tire there is placed a pair of collars, each collar having a tapered surface which contacts with an opposed taper on the other collar of the pair, that is to say, the outside of one collar is turned tapered to engage the inside of the collar which is bored with a taper running in the opposite direction. Hence, it will be apparent that by forcing these two collars in opposite directions, provision is made for their expansion, thus serving the double purpose of centering the tire on the wheel and clamping it firmly in position. This method is the means of enabling tire-turning operations to be accurately and rapidly performed, to put them back into condition to be returned to distributing points along the line, from which they will be drawn for use as the occasion for so doing presents itself.

In Fig. 14 there is shown one end of a Niles-Bement-Pond wheel lathe equipped with an expanding chucking device of the type which has just been mentioned. It is in use in the Chicago & Northwestern Railway Co.'s shops in Chicago. In this illustration, the two tapered collars are shown at *A* and *B*. Three bolts *C* slide through collar *A*, and are provided with hooks at their opposite ends, which engage the projecting edge of collar *B*. By tightening the nuts, bolts *C* pull collar *B* across collar *A*, thus causing the opposed tapered surfaces to expand the chuck and grip the work in the manner previously described. Aside from the chucking, there is nothing unusual about this operation.

Re-turning Treads of Engine Wheels

In re-turning the treads of engine wheels, it is required to reduce all of the wheels to a uniform diameter; but, it is equally important to do this work in such a way that a minimum amount of metal is removed. With this object in mind, the method of procedure followed in the Burnside shops of the Illinois Central Railroad Co., is to carefully measure the thickness of the tires on all of the wheels in a set, and after the pair of wheels has been found on which wear has reduced the tires to the greatest extent, this pair is taken to a wheel lathe illustrated in Fig. 15, to provide for re-turning the tires to obtain the necessary degree of

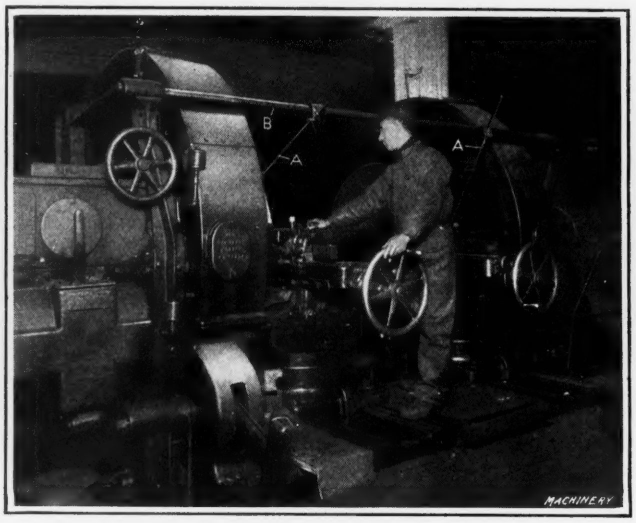


Fig. 15. Re-turning the Treads of a Set of Engine Wheels. Gages A test Uniformity of Size

accuracy. This machine was built by the Putnam Machine Co., Fitchburg, Mass. After the first set of wheels has been finished, the gages *A*, carried on an over-arm *B* on the lathe, are set to just contact with the turned treads of the wheels, and then each successive pair of wheels on the engine is brought to this lathe and the treads are re-turned until the same gages just come into contact with their finished surfaces. Handled in this manner, assurance is obtained that all wheels are brought to the same size. The time is one hour and twenty minutes from floor to floor.

Boring Locomotive Wheel Tires

There is nothing unusual about the work of boring a locomotive wheel tire, but in Fig. 16 there is illustrated a special machine built by the Niles-Bement-Pond Co., for use in the Chicago & Northwestern Railway Co.'s shops, which is furnished with a chucking device that enables the work to be set up with a minimum loss of time. On the boring machine table there are four universal chuck jaws that are operated by turning a single lever *A*, these jaws being depended upon to center the work from the outside diameter of the tire. However, the grip of the jaws could not be depended upon to hold the work down, especially in view of the toughness of the steel to be turned, unless special means were provided for that purpose.

In the present instance, this is accomplished by means of four independent hooks *B*, each of which is carried by a

block secured to the boring machine table. Each of these hooks is pivoted in such a way that after it is swung up to engage the top of the tire, a key *C* may be quickly driven into place to hold the hook in engagement with the top of the work. The merit of this boring machine equipment is that the location of the tire by means of the universal chuck jaws and the holding down of the work by the four independent hooks can all be accomplished in a very short period of time by an unskilled laborer employed to help the boring machine operator; and after the tire has been bored, the same man can remove it from the machine without delay.

Special Micrometer for Fitting Tires to Wheel Centers

In fitting a tire it is necessary to have the bore of such a size that it can be shrunk on the wheel center and held with the proper degree of tension. Fig. 17 illustrates a set of special inside calipers used for testing the bore of a tire to assure having it of the proper diameter to fulfill such conditions. These calipers were developed in the shops of the Chicago & Northwestern Railway Co., and they are used to assure fitting tires in accordance with the American Railway Master Mechanics' standard of practice, which was adopted in 1909.

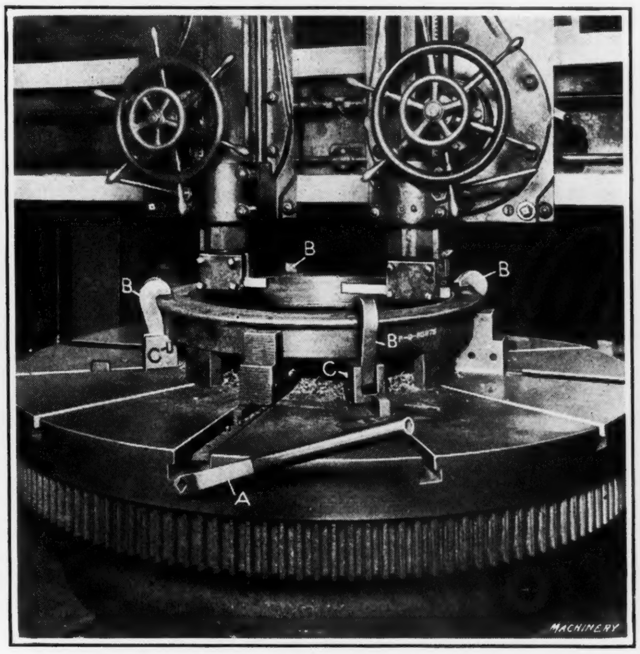


Fig. 16. Locomotive Wheel Tire-boring Machine with Universal Chuck having Quick-acting Jaws for centering the Work

In fitting tires on locomotive wheel centers, there are two contingencies which require consideration: First, where a new tire is being especially bored to fit a given wheel; second, where it is required to ascertain the thickness of a shim which must be placed between a wheel center and a tire, the bore of which is slightly too large. The calipers illustrated provide for making the necessary measurements in handling both of these classes of work.

It will be seen that there are a number of different caliper bars contained in a rack in the cabinet, each bar being threaded at one end to receive the special measuring head. Obviously, the allowance which must be made in the bore of a tire in order to obtain the desired result in shrinking it on a wheel center will vary according to the diameter of the wheel. At *A* is shown a set of shrinkage gages, of different thicknesses. Each gage is marked with the diameter of the wheel for which it is used in setting the inside caliper to obtain the proper compensation in the diameter of the bore, in order to shrink the tire on the wheel center and have it held with the required tension. The use of these gages and of the inside calipers will be best understood by briefly describing the two conditions under which tires have to be fitted to their wheels.

Considering first the case in which a new tire is being bored to fit a wheel center, the method of procedure in using the inside caliper is as follows: The diameter of the wheel center is measured with a large pair of outside calipers; and with the proper shrinkage gage *A* between the base of the hub of the graduated dial *B* and the knurled nut *C* that is carried on the threaded diameter of this hub, the length of the inside caliper is carefully adjusted to be exactly equal to the diameter of the wheel center. Then the shrinkage gage *A* is removed from beneath nut *C*, which allows this nut to be screwed down, thus reducing the length of the inside caliper by an amount equal to the thickness of gage *A*. This sets the caliper to the size to which the tire must be bored in order to be properly shrunk on the wheel center.

Where it is required to ascertain the proper thickness of sheet iron from which to make a shim for use between a wheel center and a tire that has been bored over size, in order to provide for shrinking such a tire on the wheel center in accordance with the American Railway Master Mechanics' standard of practice, use is made of the graduations which are furnished on dial *B* for that purpose. As in the previous case, the first step is to use a pair of outside calipers for measuring the diameter of the wheel center and then, with the zero graduation on dial *B* under the finger *E*, the inside caliper is set to this size. The caliper is then taken to the tire that is to go on the wheel center, and nut *C* is turned back until the length indicated by the caliper has been increased sufficiently so that its ends contact with opposite sides of the bore in the tire. The operator then observes the number on dial *B* which is beneath finger *E*. This dial has been graduated in such a way that it shows the gage of sheet iron which must be used in making a shim, in order to shrink the tire on the wheel in conformity with standard practice.

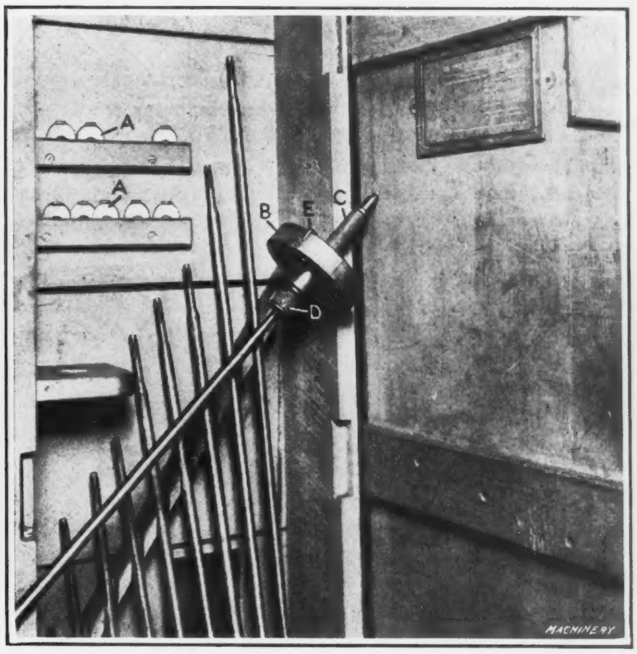


Fig. 17. Special Micrometer Calipers for fitting Rebored Tires to Wheel Centers, making Allowance for the Required Shrinkage

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SPRING MEETING OF THE A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held in Chicago, May 23 to 26, with headquarters at the Congress Hotel. The Chicago sub-committee will arrange for one special session devoted to the engineering development of Chicago as a traffic gateway to the Middle West. The technical program will include important sessions arranged for by the professional sections on aeronautics, fuels, machine shop, management, materials handling, ordnance, power and railroads.

Industrial Conditions in Germany

From MACHINERY'S Special Correspondent

Berlin, March 5, 1921

AT the end of 1920, the situation in the iron and steel industry of Germany was decidedly better than it had been earlier in the year. The factors that hampered production in the early part of the year were not entirely removed, however, and the difficulties due to the lack of coal cannot be minimized. A generally pessimistic tone prevails. In the machine building industries, coal continues to be very scarce, although the supply of other raw materials, especially iron and steel, has been sufficient. The automobile, motor truck, engine, and boiler industries are suffering from lack of orders. The same is true of the watch industry. But the shipyards, having been supplied with raw materials to a sufficient extent, are very busy. The optical and fine mechanical instrument fields report slight improvements. The machine tool industry leaves much to be desired, but the small tool industry shows a decidedly better status than that of machine tools. The file factories are well employed.

Machine tools are being offered at low prices. It is said that shapers with 18-inch travel of the ram have been offered at less than 10,000 marks (present exchange, $160). On the average, precision lathes are being offered at a price slightly over 6 marks per pound (present exchange, 10 cents per pound). The special export tax that was imposed during the past year was removed on December 25 on metal-working machinery.

General Industrial Situation

According to official statistics, covering over 15,000 plants with nearly 1,200,000 workmen, about 85 per cent of the plants were fully employed at the end of the year. About 8 per cent of the plants were working short time, while the remainder appear to have been shut down. Of the plants working short time, the number of working hours varied from less than 24 a week to 45. The number of men in the union of metal workers entirely out of employment was 2.2 per cent, while 8.53 per cent were working on short time.

The lack of employment is caused in most cases by lack of orders and not by lack of raw materials. The industrial depression has been particularly noticeable in Chemnitz, Giessen, Dortmund, Karlsruhe and Mittweida, the great centers of the machine tool industry. Lack of raw materials is reported from a few places only, and in these cases it is mainly lack of coal.

The combinations and consolidations going on in the German industry, whereby the producer of raw materials combines with the builders of the finished product, are still going on. The latest report is the combination of the machine building plants of the Augsburg-Nuremberg with the Gutehoffnungshuette, from which great advantages are expected for both companies.

Foreign Business Placed in Germany

Some big orders have been placed by foreign buyers in Germany, notably a large order from Japan, and an order for 100 locomotives from Russia. Rumania has placed repair orders for 300 locomotives with German shops, the Prometheus Werke, of Hanover, being chiefly interested. The American Steel Engineering & Automotive Products, Ltd., of Berlin has obtained orders from the United States for the German hardware industry amounting to 30,000,000 marks. The same firm imported from the United States in 1920, 16,000 tons of steel for shipbuilding purposes. Otto Wolff, of Cologne, has obtained from the Hungarian Government an order for supplying railway material to that country to an amount of 200,000,000 marks.

Figures covering the imports and exports of machine tools are being compiled, but it is not yet known when these will be available for publication. There appears to be some reason for keeping these figures confidential, and it is not yet known if they will be published at all.

Labor Conditions

Strikes appear to have lost their vigor. A strike at the Ludwig Loewe works was settled by a compromise after three weeks. The workers in general seem to conceive the seriousness of the country's situation and are fulfilling their tasks with greater willingness. Investigations into the labor efficiency in the iron and steel industries have shown that the yearly output of a workman in Germany in 1920 was less than 50 per cent as compared with 1913. At the same time, wages, as expressed in marks, have increased ten to fifteen times per unit of production. Considering the high prices for raw materials, it may be said that the present actual costs of German products, as expressed in marks, are from twenty to forty times the costs in 1913. Expressed in dollars, these costs would be from 25 to 150 per cent higher than the costs in 1913.

Present Wages in Germany

In Berlin, lathe-hands are paid 7 marks (present exchange, 11 cents) per hour. (All equivalents in American currency in the following are figured at the exchange rate at time of writing: 1 mark equals 1.6 cents.) Leipzig machinists receive from 5.10 to 7.50 marks (from 8 to 12 cents per hour; the higher figure applies to piece-workers). Unskilled workers in Leipzig receive from 4.40 to 5 marks (from 7 to 8 cents per hour). The working hours are 46 per week, and the men are allowed from three to eight days annually with pay. The wages in other parts of Germany are generally around 5 marks (8 cents) per hour, with an additional 0.5 mark (approximately 1 cent) per hour paid to workmen of more than twenty-four years of age, and a small addition amounting to about 1 mark (about 2 cents) a day, for each child.

Workers in the industries not employed by the hour but by the month are receiving wages as follows (these examples are taken from Lübeck): Office employes—clerks, from 540 to 760 marks per month (present exchange, from $8.60 to $12.20). The more highly paid office employes, who carry on independent work, are paid from 700 to 1050 marks per month (from $11.20 to $16.80); while those in leading office positions are paid from 1050 up to 1230 marks per month (from $16.80 to $20). Chief engineers receive 350 marks ($5.60) per month additional.

In the shops, the simplest work paid for by monthly wages, varies from 540 to 950 marks monthly (from $8.60 to $15.20); while higher classes of work are paid for at the rate of from 950 to 1360 marks per month ($15.20 to $22). Foremen receive from 950 to 1325 marks per month (from $8.60 to $21.25); and other executives about 1500 marks per month (about $24). In addition, all employes more than twenty-five years of age, receive an additional 400 marks per month ($6.40) if married, and 275 marks per month ($4.40) if unmarried.

News of the German Machine Tool Industry

The Fritz Werner Machine & Tool Works, of Marienfelde near Berlin, is said to be the best equipped factory for the manufacture of machine tools and small tools in Berlin. This factory has been hard hit by the crisis, and is now working on stock only. The Wandererwerke of Schoenau, near Chemnitz, are able to give a better report. The sales in the fiscal year 1919-1920 of milling machines, bicycles, and typewriters amounted to ten times the capital stock, and made possible a dividend of 35 per cent; the capital has been increased to 21,000,000 marks.

The Zimmermannwerke of Chemnitz, the oldest machine tool plant of Chemnitz, had a better business year during the past year than the year previous. The sales of machine tools increased considerably, and it is said that orders amounting to 40,000,000 marks are on hand. Favorable prices for raw materials have been obtained from abroad, and two large boring mills at a price amounting to several millions of marks, have been shipped to foreign buyers.

The Defrieswerke of Cologne have expanded during late years and are now establishing large warehouses for machine tools and tools in general in Vienna and Budapest in order to supply the Balkan countries from these places. It is said that a very good business is expected from the Balkan countries, especially in tools of various kinds. The Defries firm handles not only the products of the Defrieswerke, but is also selling machine tools built to Defries designs by other firms. For example, Borsig of Tegel, near Berlin, is said to be executing an order for the Defries interests for machine tools; this is interesting, inasmuch as the Borsig works are locomotive builders, and this is the second case where a German locomotive builder turns to the building of machine tools. The well-known locomotive builder I. A. Maffei of Munich, recently took up the building of machine tools.

The Borsig concern was for more than eighty years an individually owned business, but a few weeks ago it was reorganized as a corporation with a capital of 30,000 000 marks. The Borsig works of Upper Silesia have also been incorporated with a capital of 35,000,000 marks. The shares of both the companies remain in the hands of three members of the Borsig family.

As to the results obtained by other machine tool builders in Germany, it might be mentioned that the last dividend of Reinecker, Ltd., of Chemnitz, was 20 per cent; that the machine tool works of Gildemeister of Bielefeld report satisfactory business, although they are somewhat uncertain as to the future; and that the well-known manufacturer of automatic screw machines, the Leipziger Werkzeugmaschinenfabrik, vorm. W. v. Pittler, was able to pay a dividend of 15 per cent last year in spite of the great difficulties in the German machine tool industry. These firms, which must be considered among the leaders in the industry, are in a much better financial condition than the large number of the machine tool builders, who have suffered greatly from lack of business.

* * *

SPRING CONVENTION OF THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

At the meeting of the National Machine Tool Builders' Association, held in Cleveland February 24, 25, and 26, it was decided to hold the regular spring convention of the Association in Atlantic City, May 19 and 20, notwithstanding the fact that at first it was believed that the meeting in Cleveland might take the place of the spring convention. The general consensus of opinion was that at the present time machine tool builders ought to come together again in a few months to discuss the important problems now facing the industry; and in accordance with this sentiment, a vote was taken to hold the spring convention in Atlantic City on the same dates as originally planned.

BELT-DRIVEN FORGING HAMMER

Our attention has been called to the fact that the belt-driven 200-pound forging hammer described on page 658 of the March number of MACHINERY, as having been shown at the recent British exhibition, is an exact duplicate of the Beaudry "Champion" type of hammer which is manufactured by Beaudry & Co., Inc., 45 Bromfield St., Boston, Mass. The machine as shown in the March number, and designated by the British concern building it as a 200-pound forging hammer, is identical with the Beaudry No. 6, 150-pound hammer of which we are informed that it is an exact copy.

We are further informed that this is the second time that the Beaudry machine has been copied by a British concern. The first instance occurred in the early nineties. As the British patents were then in effect, the imitation was stopped after the expenditure of a considerable amount of time and money. There has been much complaint in the past about German and Japanese concerns copying American machine tools, but there has been but little attention paid to the copying of American models that has taken place in England as well as in France. Honor to whom honor is due is particularly adaptable to developments in machine tools, and we are pleased to be able to correct the impression created by the article in the March number, and to give credit to Beaudry & Co., Inc., the originators of the design.

* * *

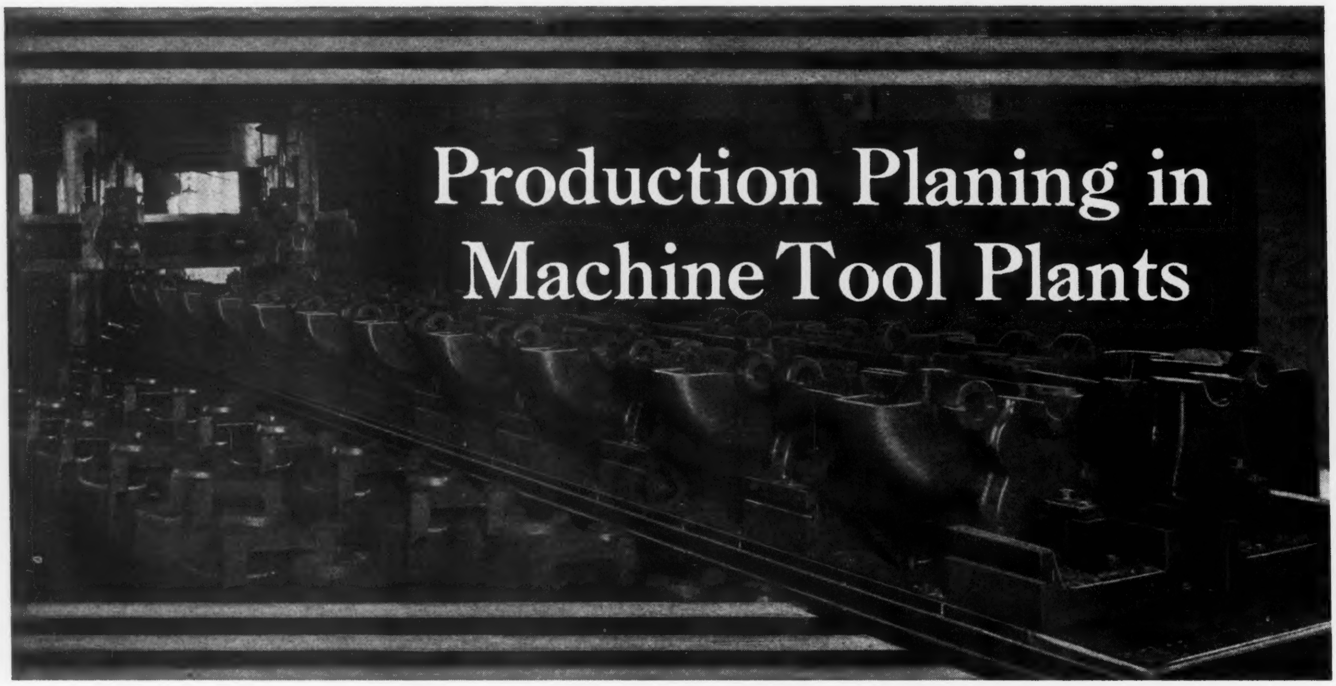
THE EFFICIENCY OF INDUSTRIAL WORKERS

An interesting contribution on the subject of the efficiency of industrial workers is made by H. D. Thweatt, of the Van Dorn & Dutton Co., Cleveland, Ohio, in a recent number of *Industrial Management*, from which the following is taken: At a recent meeting of production engineers in Cleveland the question was raised as to whether or not the average workman of today is really producing less than he was before the war. The speaker of the evening commented on the large amount of space in current magazines devoted to the problem of greater production, and said that it would be interesting to obtain an expression on the subject from those present. As a result, the chairman requested that each one give his opinion of the matter as obtained from his particular class of manufacturing. The men present represented textile, foundry, and metal-working trades, and their statements were similar but apparently at variance with the present consensus of opinion.

The discussion had not proceeded very far before a sharp line had been drawn between the piece-workers, or the men with direct incentive, and the unskilled workman, who in most places has no incentive beyond his straight day wage. Nearly everyone stated that, as far as his experience was concerned, the piece-worker was producing more than ever before and that the increased production was not due to improved factory methods entirely, but that in their opinion the piece-worker was really working harder than ever. On the other hand, everyone was agreed that the laborer had fallen from his former place. One man was able to present figures showing that the output per man had increased more than 2 per cent, but did not state what proportion was due to the workman's effort alone. In connection with this it is interesting to study the statement of the White Motor Co. to the effect that the number of trucks produced per man has increased from 1.785 in 1913 to 2.751 in 1920. Of this increase the workman is credited with one-third.

* * *

The principal constituent of aluminum solder is tin. There are many different soldering compositions which have been used with varying success for aluminum ware, but the following composition is said to have been found satisfactory for this work: Tin, 68 per cent; zinc, 29 per cent; antimony, 2 per cent; and phosphorus, 1 per cent.



Production Planing in Machine Tool Plants

Practice of Shops Engaged in the Manufacture of Drilling and Boring Machines and Heavy Lathes—Fourth of a Series of Articles

IN the building of drilling and boring machines and heavy-duty lathes, a number of planing operations are required in the process of finishing the columns, beds, and other large castings used in the construction of these types of machine tools. The accompanying illustrations show examples of the practice of several well-known plants engaged in the production of such machines, and the examples which have been selected for discussion will prove of interest both because of the ingenious fixtures and tools that have been developed, and because of the possibility of employing similar methods of planing on many other classes of work besides the parts of machines to which specific reference is made.

Planing Columns of Cincinnati Bickford Vertical Drilling Machines

In Fig. 1 is shown the work of planing, on column castings, the dovetail bearing for the sliding head of vertical drilling machines built by the Cincinnati Bickford Tool Co., Cincinnati, Ohio. It will be seen that this job is done on a planer built by the Cincinnati Planer Co., two of the drilling machine columns being set up side by side so that they can be planed simultaneously. As these castings come to the machine they have been rough- and finish-turned and finish-ground, and this accurate cylindrical surface is used as a locating point for the performance of the planing operations. From the illustration it will be evident that each casting is held by two V-blocks *A*, which engage the forward and rear ends of the ground cylindrical part of the work. The castings are held down in the V-blocks by means of two straps *B* which straddle the space between the work, and provision is made against the thrust of the tools causing lateral movement of the work by means of end-stops *C*. At the end nearest the planer cross-rail, the work is held down by means of a strap *D*, which enters the cored opening in each drilling machine column. It will also be noticed that under this end of each casting there is a small jack-screw *E* that supports the overhanging portion of the work.

Arrangement of Tool Equipment on the Planer

Two rail-heads are provided on this machine, and they are used simultaneously, the tool in each head operating on one of the two castings that are set up side by side on the table of the planer. Carried by two brackets *F* (not clearly shown in the illustration), there are tool-setting gages of the familiar form, consisting of templets of the same size and shape as the finished work, against which the planing tools can be set to provide for finishing the work to the required dimensions. Such an arrangement is the means of greatly facilitating tool setting, and thus not only reducing labor costs but also cutting down the idle time of the planer during the setting up period, which is often a very important factor in expediting production. The operations performed at this setting of the work consist of rough- and finish-planing the horizontal top face of the bearing, rough- and finish-planing the inclined sides of the dovetail, and rough- and finish-planing a groove at the center of the bearing that receives the rack for adjusting the position of the head on the machine column.

There is nothing unusual about the work done on this planer.

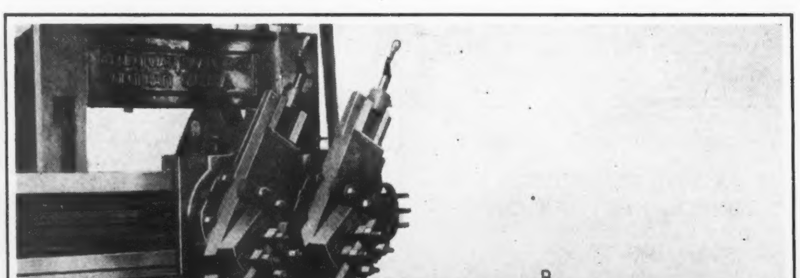


Fig. 1. Simultaneously planing Dovetailed Bearing for Sliding Head on Two Upright Drilling Machine Columns

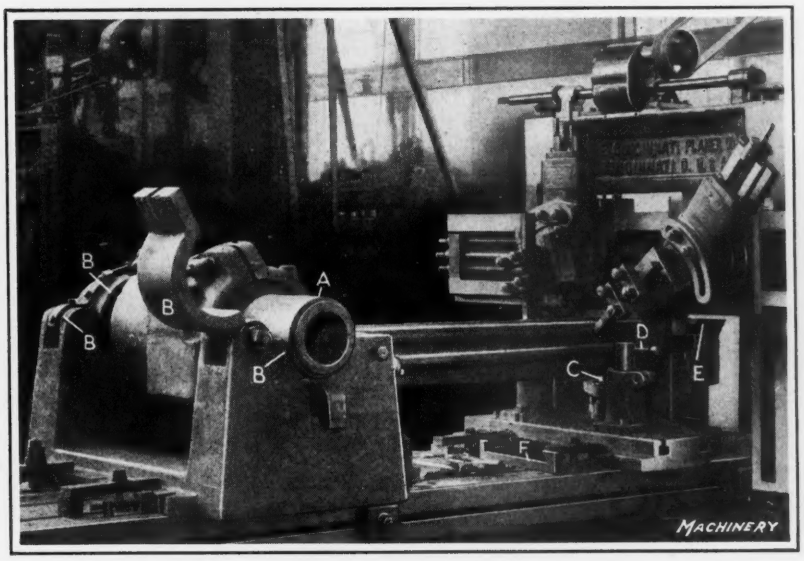


Fig 2. Fixture with Mandrel and Bearings for supporting Radial Drill Arm while planing the Dovetailed Bearing for the Drill Head

The tools used on the horizontal top face and in the guiding groove of each casting are shown lying on the planer table, and the double-ended tools for rough- and finish-planing the inclined sides of the dovetail are shown in place in the rail-heads of the machine. Each of the tools is forged and ground at one end to the shape required for roughing out the dovetail, while the opposite end of the tool is made for performing the finish-planing operation. A high degree of accuracy is necessary on this job, and in the illustration there is shown a plug gage *G* for testing the width of the tongue groove that is planed at the center of the bearing, and a gage *H* for inspecting the form of the dovetail.

Planing Arms of Cincinnati Bickford Radial Drilling Machines

On Cincinnati Bickford radial drilling machines, the arm is supported by a vertical bearing in a boss at the left-hand end of the arm. The first operation performed on these castings is the boring and reaming of the bearing, which is subsequently employed as a locating point for the performance of other machining operations. Fig. 2 illustrates how this finished cylindrical opening in the work is utilized in setting up the arm casting for performing the necessary planing operations for the drill head bearing on the rail. From this illustration, it will be apparent that an arbor *A* is made to fit the finished bearing accurately, and this arbor is slipped into place and held in bearings *B* provided on a planer fixture for that purpose.

Prior to the time that the work is set up, care has been taken to square the fixture properly with the line of travel of the planer table, and hence it will be evident that the casting is held in such a way that the drill head bearing on the radial arm will be properly planed in relation to the finish-bored bearing by which the arm will subsequently be supported on the column of the drilling machine. Under the forward end of the work there is a jack-screw *C* that provides for leveling up the casting ready for performing the planing operations, and at each side there are two posts with screws *D* that hold the work against sidewise deflection. Also there is a strap which enters a cored opening at the end of the work nearest the planer cross-rail, to provide for holding it against lifting while it is being operated upon.

As in the previous case, a tool-setting gage *E* is provided at the back of the planer table to facilitate locating tools for taking successive cuts. The planing operations performed on the dovetail bearing for the radial drill head are of approximately the same nature as the corresponding operations on the column of the vertical drilling machines, previously described. The form of the finish-planed work is tested with gage *F*, and the spacing between the sides of the dovetailed bearing is measured with a micrometer caliper. From the illustration of the set-up of the Cincinnati planer used for the performance of this job, it will be apparent that two rail-heads are employed simultaneously, one of which carries a tool that operates on the horizontal face of the work, while another tool is utilized on one of the inclined faces of the dovetailed bearing. For the performance of the sequence of operations required on these castings, the time consumed in setting up the job and doing the planing is 3½ hours.

Planing Heads for American Radial Drilling Machines

Fig. 3 shows a 54- by 36-inch planer built by the American Tool Works Co., of Cincinnati, Ohio, which is used in the plant of this company for planing the arm bearing in head castings of American radial drilling machines. Six castings are set up on the planer table in independent fixtures; and as they come to the machine, the cover fit has been planed on these castings and this finished surface is used as a locating point. The cover fit is flat with a shoulder at the left-hand end of the work as it is shown, so that one of these castings can lie on the planer fixture with its planed shoulder drawn up against the finished edge of the fixture, thus locating the work ready for planing. Provision is made for holding each casting in place on its fixture by means of a strap and bolt *A*, which pulls the shoulder on the work up against the fixture, while provision is made for holding the work down by means of two other straps, one of which is shown at *B*. The third strap, which is not shown, bridges the gap between two adjacent castings so that it exerts a clamping pressure on each.

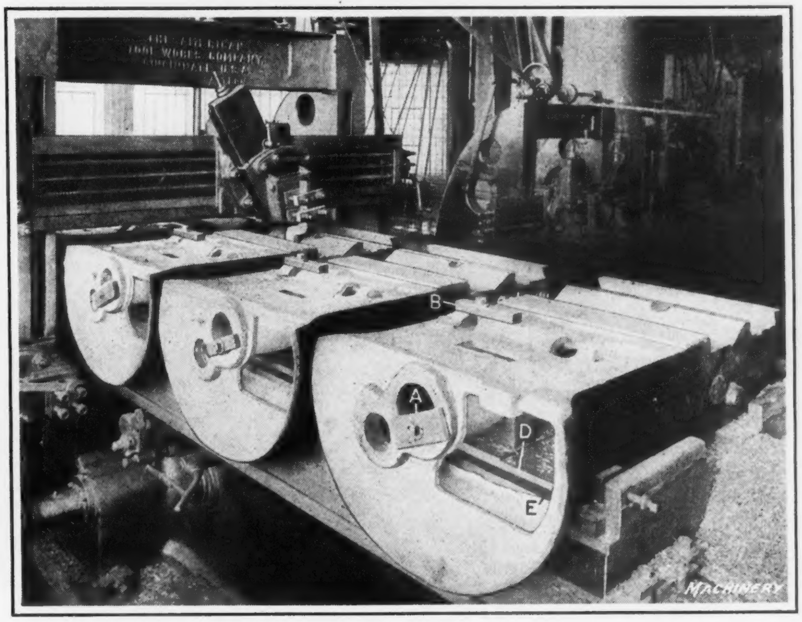


Fig. 3. Planer equipped with a String of Fixtures for supporting Castings for Radial Drill Heads while planing the Arm Bearing and the Tapered Gib Seat

By referring to the illustration Fig. 4 it will be seen that there is a tool-setting gage *C* of the type commonly used for locating each of the tools employed for the performance of a sequence of planing operations. In setting tools for taking the

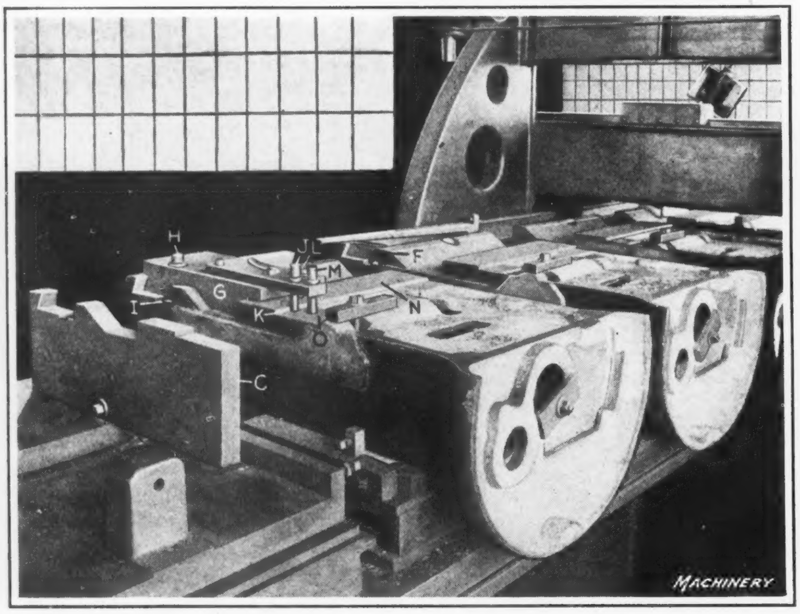


Fig. 4. View of Planer shown in Fig. 3 from the Opposite Side of the Housings. Here are shown Gages provided for testing the Accuracy of the Planed Surfaces

roughing cut, a practice is made of leaving 0.010 inch of metal for removal by the subsequent finishing cut. The cuts taken on horizontal, vertical, and inclined faces are done with tools of the forms which have been discussed in connection with descriptions of previous planing operations. A cutting speed of 45 feet per minute is employed in all cases, while roughing cuts are taken with a feed of 1/16 inch and finishing cuts on horizontal surfaces with a feed of 3/8 inch per table stroke. On vertical and inclined faces, the commonly used rate of feed is 1/4 inch.

Application of a Tapered Work-setting Strip

There is a principle employed in the performance of this sequence of planing operations, which is used in various ways where it is required to plane one side of a piece of work at a specified angle to another side that is finished at the same setting. In the present instance, the use of this principle is made necessary through the need of first planing the inclined side of the dovetailed bearing and then planing the seat for a tapered adjusting gib at a specified angle to the inclined side of the bearing. This result is accomplished in a very simple manner. It has already been explained that the casting is located by abutting a previously planed shoulder on the drill head cover fit against a finished edge of the fixture, the work being held back in this position by means of strap *A*, Fig. 3. Such a setting holds the work in place for planing the dovetailed bearing, and after this has been finished it is necessary to loosen the three clamps that hold each piece of work, and to reset the casting at such an angle that it is held in the proper position for planing the angular surface which constitutes a seat for the tapered gib.

This result is accomplished by the following method: For planing the straight side of the dovetailed bearing, the shoulder on the planed under side of the work is clamped against face *D* of the fixture. Then to reset the work for planing the tapered seat for the adjusting gib, the clamps are released and a tapered strip *E* is inserted between the edge of the fixture and the shoulder on the work, after which the straps are tightened by first screwing home the nut over strap *A* and then tightening up strap *B* and the third strap, which is not shown. It will be evident that locating strip *E* must have the same taper as the gib that will subsequently be used in adjusting the fit of the finished drill head bearing on the radial arm; and to plane the work in a way which fulfills this condition, it must be inclined from its previous position at an angle equal to the taper of the gib. The operator can then proceed to plane the gib seat in the radial arm bearing in the drill head.

Gages Used for Testing the Finished Work

In the performance of planing operations on these radial drill head castings, it is required to have a definite relationship between the positions of individual faces planed on the work. Fig. 4 illustrates a set of gages for determining the accuracy of the results which have been obtained. At *F* there is shown a gage-block used for determining the accuracy of form of the dovetailed bearing, this block being used with a film of red lead to ascertain whether the bearing has been properly finished. For checking up the relative positions of the various surfaces which have been planed on the casting, use is made of a gage *G* that carries a number of plugs which afford means of ascertaining the accuracy of the dimensions on which limits are specified.

Plug *H* measures from the top surface of the work to the bottom of groove *I*. This plug is of a diameter equal to the width of a rack which will be assembled in slot *I*; and to assure the rack entering its seat, plug *H* is required to turn freely in slot *I*. Plug *J* slips down in contact with the side of shoulder *K* to ascertain the accuracy of its position relative to other fixed points on the work; and plugs *L* and *M* are used for determining the respective positions of faces *N* and *O*. This gage is used in conjunction with a feeler 0.0015 inch in thickness. There must not be room for such a feeler to enter the space between plug *J* and shoulder *K* with the gaging plug in place; and on all horizontal surfaces, the feeler must be held under the base of the plug, but it must not be held between the plug flange and the body of the fixture with the plug pushed down as far as it will

Fig. 5. Open-side Planer equipped for machining a String of Three Castings for Tables of Horizontal Boring Machines

go. The latter condition would indicate that the bottom of the plug failed to reach the work; otherwise, the flange would not hold the feeler against the frame of the fixture. A further test of the accuracy of the planed work is made by bringing a dial indicator successively into contact with the four corners of the finished top surface. To pass inspection, it must not show a variation of over 0.002 inch. For the performance of this planing operation, the time is thirty-one hours for planing six castings.

Planing Tables for Cleveland Boring Machines

In building horizontal boring machines, the Cleveland Machine Tool Co., Cleveland, Ohio, uses open-side planers built by the Cleveland Planer Co., for machining many of the larger parts of its product. Fig. 5 shows the work of planing a string of three table castings, the operation here illustrated being the first one performed on these pieces. The method of setting up the castings for planing is so simple that it hardly calls for a description. It will be seen that there are three castings set up end to end, and that they are carried on small jacks *A* which level up the castings, while the end pressure is supported by two stops *B* of a commonly used type, straps *C* being employed to hold the castings down. The operation performed at this time consists of planing the sides of the table and the top surfaces and dovetailed bearing for the table on the saddle, by which it will subsequently be secured to the bed of the boring machine.

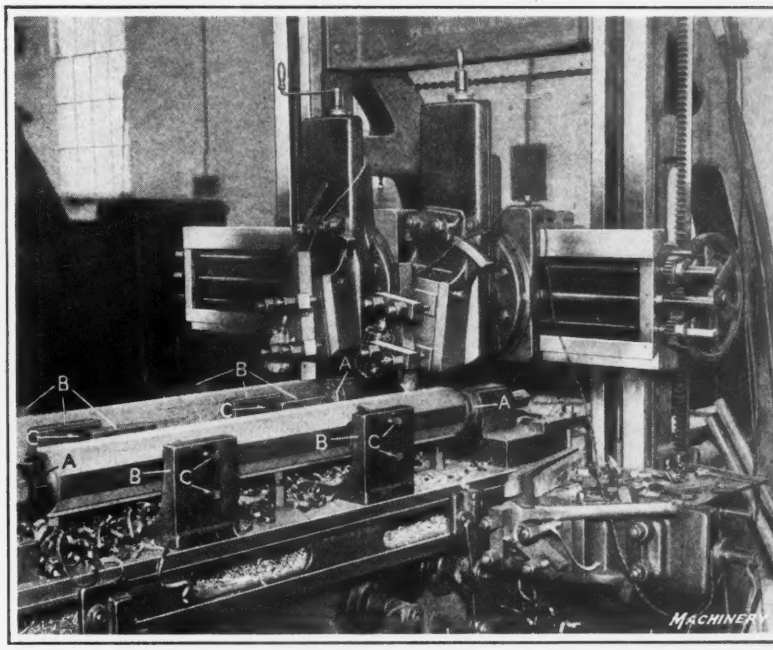


Fig. 6. Method of planing Octagonal Bars for Boring Machines. After planing Each Successive Side the Work is reset from the Previously Planed Side

Corners of Square-nosed Tools Used as Single-point Tools

It will be noticed that two rail-heads are provided on the planer in order that provision may be made for operating simultaneously on two faces of the work, thus reducing the time required to complete the sequence of machining operations. In the illustration are shown the tools used for planing the sides of the tables, the top faces, and the clearance space between the dovetailed bearings. It will be seen that these tools are held at an angle, so that the vertical feed of the heads can be utilized for running the tools down the sides of the castings, the cuts being taken with the corners of the tools. By feeding the heads horizontally along the rail, the opposite corners of the tools can be used for rough-planing the two top faces of the work and the clearance space between the dovetailed bearings.

Next, the heads are set at an angle of 45 degrees, and single-point tools are used for rough-planing the inclined sides of the dovetailed bearings; and with the same tool setting, but using a horizontal feed of the planer heads along the rail, provision is made for roughing the horizontal faces of the dovetailed bearings. Finishing cuts on all horizontal surfaces of the work are then taken with broad square-nosed tools of the gooseneck type, and the sides of the tables are planed with side finishing tools, while the inclined faces of the dovetailed bearings are finished with dovetail finish-planing tools. The time required for performing these operations on three table castings is 5½ hours.

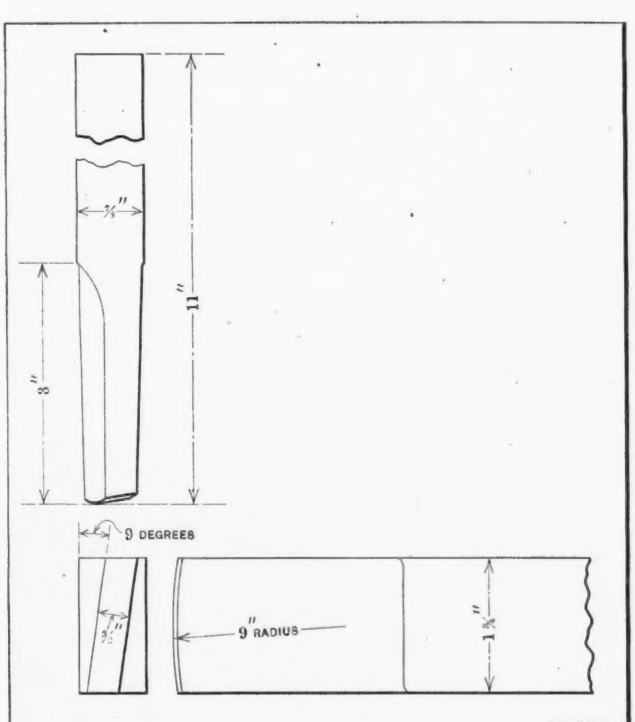


Fig. 7. Shearing Type of Tool used for the Performance of Finish-planing Operations on Steel

Planing Boring-bars for Niles Boring Mills

On vertical boring mills built by the Niles Tool Works Co., in Hamilton, Ohio, the boring-bars are machined from steel forgings which come to the machine shop in a rough octagonal form. In the condition in which they are delivered to the planer, the ends of these forgings have been cut off, faced, and centered, so that they may be set up on centers as shown in Fig. 6. There are four bearing faces on these bars that are rough- and finish-planed, and four intermediate faces that are also rough- and finish-planed. In setting up this job, the method of procedure is to first plane one surface of the work, which is used in effecting locations for the performance of subsequent planing operations. As previously mentioned, and as shown in the illustration, the work is supported on centers *A*, and it will be seen that there are eight posts *B*, four of which extend up at the side of each boring-bar forging to be planed; and these posts carry two set-screws *C* each. After the desired position of the forging has been obtained by means of a square or 45-degree angle gage, these set-screws *C* are tightened against the work to hold it in that position.

In performing the planing operations on these forgings, the method of procedure is to first rough-plane all eight sides of the bar and then finish-plane three of the intermediate faces between the bearing faces, and the rack face, after which the work is removed from the planer and sent to other departments of the machine shop, where rack teeth are cut to mesh with the pinion that will provide for raising or lowering the boring-bar as required. Next, the end of

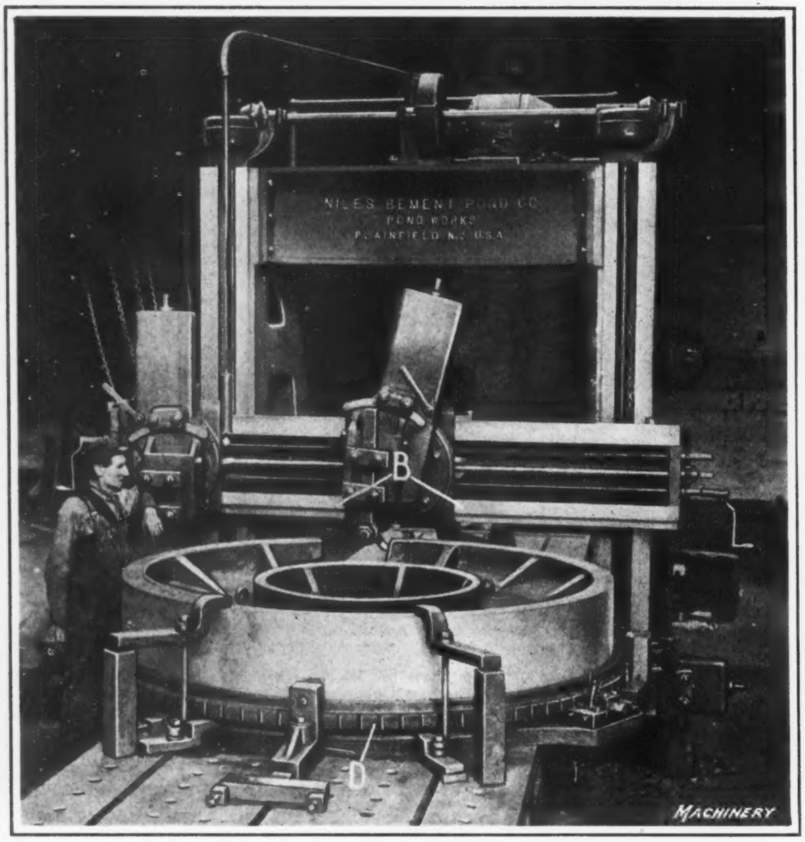


Fig. 8. Planer equipped for machining the Seat for the Removable Segment of a Car-wheel Driving Gear

the bar is bored and all necessary lathe work is completed, after which the bar is returned to the planer where a second roughing cut and a finishing cut are taken over the four bearing surfaces. The rough-planing cuts are taken with a round-nosed tool, as shown at the front of the illustration, at a speed of 45 feet per minute; and approximately 1/4 to 1/2 inch of metal is removed, with a feed of 1/32 inch per stroke. The second roughing cut removes 1/32 inch of metal, the operation being performed under the same conditions of speed and feed as the first cut.

For performing the final finishing cut, a shearing tool is employed, which is of the form shown in operation at the rear of Fig. 6, and in detail in Fig. 7. This tool has the cutting edge inclined at an angle of 9 degrees to the line of travel of the planer table, and there is a 6-degree clearance at the back of the cutting edge, which is curved to a radius of 9 inches. Tools of this kind are frequently employed for the performance of finish-planing operations on steel, and they are found capable of attaining a high degree of accuracy and perfection of finish. In the present instance, the depth of cut is from 0.003 to 0.004 inch, with a cutting speed of 45 feet per minute and a feed of 1/64 inch per stroke of the planer table.

Planing Seat for Removable Segment of Niles Car-wheel Lathe Driving Gear

On car-wheel lathes built at the Niles Tool Works Co., provision is made for setting up the wheels while they are still mounted on the car-wheel axle, thus affording a convenient means of turning the treads of the tires when they become worn. These lathes are designed to drive the work from the middle of the axle by means of a chuck carried at the center of a herringbone gear through which the drive is transmitted. For setting up the work, it is required to be able to roll the two car wheels and their axle into position to be gripped by the chuck at the center of this gear, and for this purpose there is a removable segment *A* in the rim, Fig. 9, which can be taken out to admit the axle. The seat *B* for the segment in this gear and also the sides of the segment are planed to the required form, so that the contacting surfaces will come into uniform engagement.

Fig. 8 shows a general view of a 72- by 72-inch planer built by the Niles-Bement-Pond Co., 111 Broadway, New York City, which is equipped for handling this job, while Fig. 9 illustrates a close-up view of the work and the gages *C* used for setting the tool-head for planing the angular sides of the segment seat in the gear. These car-wheel lathe driving gears are made of cast steel, and it will be seen that they are set on the planer, Fig. 8, on an indexing fixture *D* that has notches cut around its periphery so that provision may be made for first planing one side of the seat for the segment and then rotating the work sufficiently so that it is accurately located for planing the opposite side of the seat. The sides of this opening are both radial, and the indexing of the work is easily accomplished by specifying the included angle between the radial sides of the opening to be planed in the work, so that indexing may be accomplished by turning the work through a specified fraction of a circle.

As shown in Fig. 9, the rail-head is set at such an angle that the point of the cutter bit in the tool-holder contacts uniformly with the angular tool-setting gage *C* at the two extreme ends of a side of this gage, which corresponds to one side of the work being planed. In this illustration, there is also shown the segment *A* of the gear rim which has been

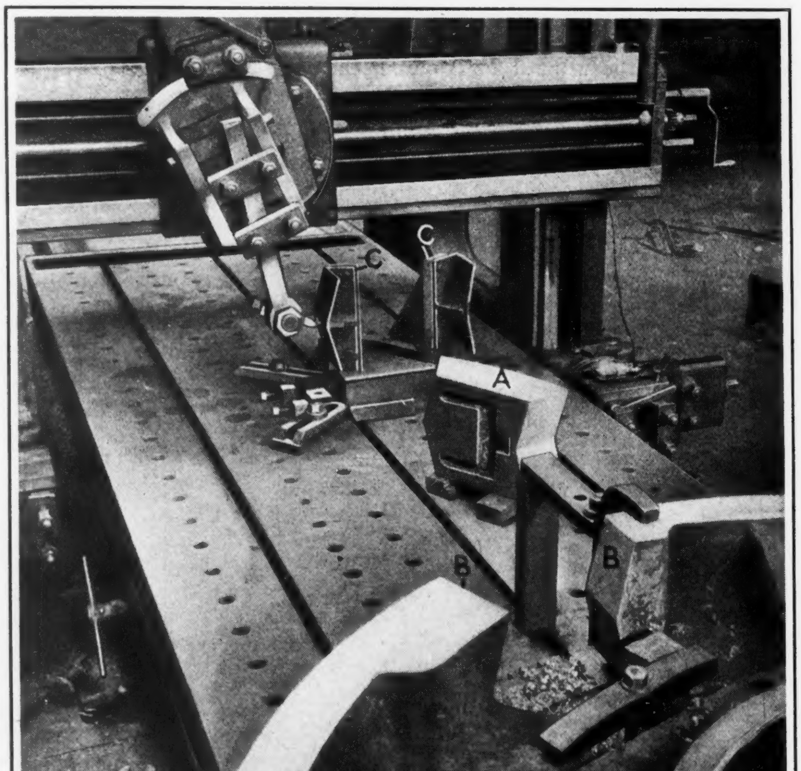


Fig. 9. Close-up View of Work shown in Fig. 8 and of the Removable Segment

planed to the proper form to fit the planed seat in the rim. The method of procedure in handling this job is similar to that on the rim of the gear, except that the angles of inclination are reversed, that is to say, a male fit on the segment engages a female fit on the rim of the gear and vice versa. This work is done on a smaller planer. Each of the surfaces to be planed on the gear and on the removable segment is 5 inches wide by 12 inches total length, and twenty hours are required to complete planing the rim of the gear.

Use of a Reach-bar for T-slotting a Sellers Faceplate

In discussing methods used for the performance of planing operations in the shops of machine tool builders specializing in the construction of planers, descriptions were given of the use of open-side planers and of independent housings for supporting auxiliary side-heads used in conjunction with the heads carried on the cross-rail and housings of planers of the usual design. Both of these equipments are especially adapted for planing work that is of such a size that there is not sufficient capacity to allow it to pass between the housings of an ordinary planer. There is still another way in which work of this general character may be handled, and in Fig. 10 this method is shown in use at the plant of William Sellers & Co., Inc., in Philadelphia, Pa., where a 90-inch faceplate is illustrated during the process of planing the under-cut portions of the T-slots. This casting would not pass between the planer housings, but use is made of a tool known as a "reach-bar" that projects out a sufficient distance from the planer cross-rail so that the work can be traversed under the tool for the necessary distance and then have the direction of table travel reversed before the work strikes the housings.

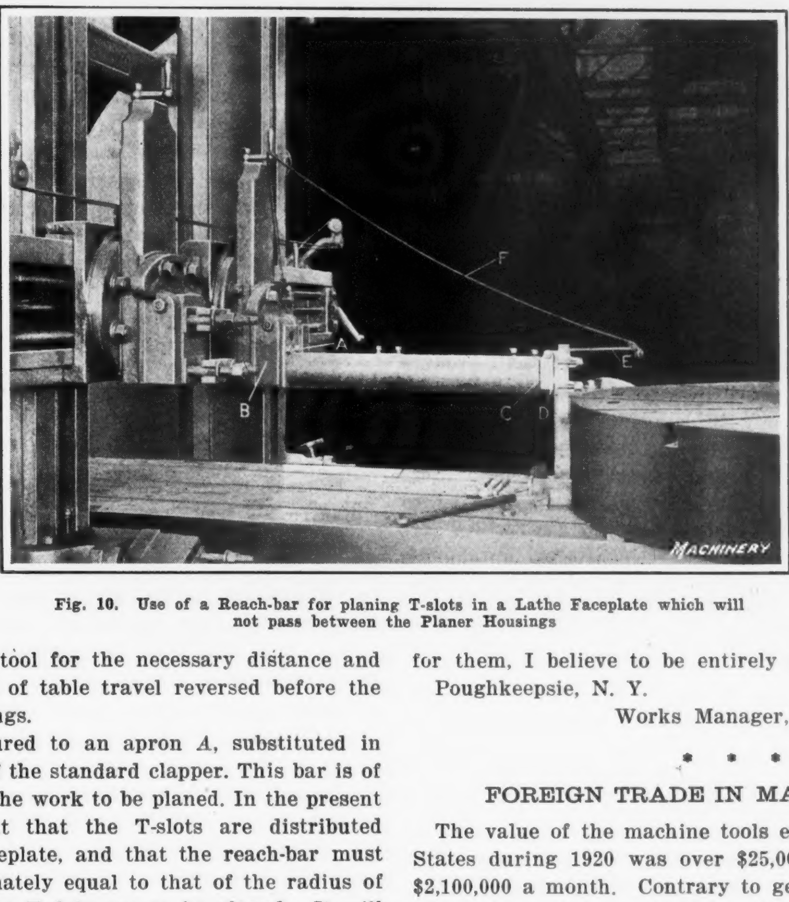


Fig. 10. Use of a Reach-bar for planing T-slots in a Lathe Faceplate which will not pass between the Planer Housings

The reach-bar is secured to an apron *A*, substituted in clapper-box *B* in place of the standard clapper. This bar is of the required length for the work to be planed. In the present instance, it is apparent that the T-slots are distributed radially around the faceplate, and that the reach-bar must be of a length approximately equal to that of the radius of the casting in which the T-slots are to be planed. It will be seen that an auxiliary clapper-box *C* and clapper *D* are provided at the front end of the reach-bar, and that a special form of tool-lifter is furnished with an arm *E* extending forward from the special clapper to give the required leverage, so that the apron may be easily lifted with a cord *F* that runs back to the operating position. Equipped in this way, the planer-hand can pull the cord to lift the tool clear of the work during the return stroke of the planer table. The cutting tool at the end of the reach-bar does not show well in the illustration; but it is of the familiar elling type used for T-slotting and other under-cutting operations.

* * *

A consular report from Mexico City states that the Minister of Finance of Mexico has signed a contract with American interests for a credit of $5,000,000 with which to purchase railroad equipment in the United States.

THE METRIC SYSTEM IN AN AMERICAN SHOP

In reply to Mr. Halsey's article in the March number of MACHINERY, entitled "The Metric Equivalent Scheme," I wish to state that when I prepared the article describing the use of the metric system in the De Laval Separator Co.'s plant, which appeared in the August number of MACHINERY, I did not intend to become involved in an argument as to which system is the better one, and I do not intend to do that at this time. I have too much else to do, even were I disposed to enter into what I consider would be a useless controversy.

My article was intended to show to other shop men just what had been done here in changing over from one system to the other and how it was done. It is an entirely frank and true statement, and I only thought it might be helpful to some others who, like myself, might be confronted with the necessity for the change for special reasons, and who might be troubled by anticipations of difficulties which in our case did not arise, and which I believe need not arise if our plan is followed and all prejudice thrown aside. The questions asked of me by Mr. Halsey might very easily be answered, but never to his satisfaction. The answers are available at our plant for anyone who sincerely seeks light upon this contentious question for actual use in machine construction; and it is perhaps sufficient for me to say that, if the formidable appearing difficulties suggested had really been encountered by us, then no result appeared from them in our cost accounts, which, though I am not personally responsible for them, I believe to be entirely reliable.

Poughkeepsie, N. Y. THEO. H. MILLER
Works Manager, De Laval Separator Co.

* * *

FOREIGN TRADE IN MACHINE TOOLS

The value of the machine tools exported from the United States during 1920 was over $25,000,000, or an average of $2,100,000 a month. Contrary to general belief, the exports of machine tools continued quite heavy during the last months of the year. In October they amounted to $1,775,000; in November, $1,950,000; and in December, $2,200 000. Of the total exports during the year, lathes of different types were exported to a value of $7,500,000; grinding machines to a value of $4,000,000; and other machine tools to a value of $14,000,000. In 1918 the total exports of machine tools amounted to $27,500,000, and in 1919 to $28,000,000. Metal-working machinery other than machine tools was exported in 1920 to a value of nearly $18,800,000, as compared with $24,000,000 in 1918 and over $30,000,000 in 1919. The United Kingdom took, in 1920, over $11,000,000 worth of metal-working machinery, and Canada nearly $6,000,000 worth. France took $7,600,000 worth and Japan $4,250,000 worth, while Belgium bought nearly $2,000,000 worth. Spain became an important customer during the year, taking $1,140,000 worth of metal-working machinery; British India, $1,375,000 worth; and China nearly $1,000,000 worth.

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SOME PROBLEMS AHEAD

The new era in production which we are entering will present many new problems for solution. During most of the past five years, demand has so exceeded supply that until within twelve months there has been little real competition in machine tools. But this condition is now definitely and permanently changed and we return to the pre-war commercial conditions under which goods must be sold on merit and by effort in a keenly competitive market. Meanwhile, the general standard of living has been raised; people of all classes demand more from life and have come to consider as necessities many articles that were purely luxuries ten years ago. These higher standards of living require greater production and lower costs if they are to be maintained. To some extent greater production may be obtained by increasing the personal efficiency factor; but mainly by the use of more highly developed machinery, which manufacturers of machine tools and of all other kinds of productive machinery should be well able to supply. The call will not be for *any kind* of machine that will turn out a given piece of work, but for some specific type that will produce the piece of work required in the shortest possible time.

This tendency is already in evidence. The builders of machinery adapted to production in quantity are receiving more inquiries than at any time since the war, and these inquiries are not so much for prices as for time estimates and for explanations of the methods by which a certain part can be produced at the lowest cost. Even in the automobile field, where we have become accustomed to think that the highest development has been reached in productive capacity, we find a great deal of effort being made to reduce production costs further.

All this holds a promise for the machine tool manufacturer. The shops of the country are full of machine tools; but whoever can design a machine that will produce the same quality of work in greater quantity and at lower cost has a good chance to replace with his machine others that are too costly in operation to compete with the newer developments. This opportunity exists in foreign as well as in domestic markets, and constitutes one of the problems which our manufacturers are now working out.

* * *

IDEAS OFTEN REPRESENT VALUE

The real value of a machine tool is not expressed by simply adding the cost of materials, of labor and the overhead. Machine tools sometimes embody production ideas that are of incalculable value in dollars and cents, and for which the manufacturer often receives but a scant return.

To illustrate—a manufacturer brings out a machine capable of producing 50 per cent more than its nearest competitor. Mechanically the machine may be only a little more complicated and the labor and material represent only a small increase in cost over the former type, so the manufacturer sells it for 20 per cent more; but its increased production may pay for its cost in a single year and the increase for some years following may be pure "velvet." The buyer or user of such a machine is the beneficiary, rather than the designer or manufacturer who is really responsible for the increased production.

Machine tool builders generally have sold their ideas too cheaply. Their prices are usually based on cost of materials, labor and direct overhead, with almost nothing for the inventive ability and costly experiments necessary. We often hear of inventors of machines and appliances used in the manufacture of typewriters, munitions, shoes and other commodities, who have received large amounts for their ideas. One photographic invention, and not a revolutionary one, is said to have netted as large a return as $300,000 to the inventor.

The success of our most prominent machine tool firms has been a slow and laborious development, sometimes covering more than one generation, because they have been satisfied with very moderate profits, even on machines which embodied radical improvements. This liberal policy has done more than can be computed to reduce prices for the general public, and we do not suggest its reversal. We simply call general attention to the fact.

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NOW IS THE TIME FOR READING

The experienced mechanic knows that it is not possible to learn his trade out of a book; it must be learned in the shop, and the teacher should be another experienced mechanic. But he knows also that good books on mechanical subjects enable the learner to acquire his trade more quickly and thoroughly. Books on machine shop practice, written by men who have had personal experience in the work they describe, will help the learner to grasp the principles underlying the methods he employs and to look beyond his daily routine. With their help he will be able to step upward on the ladder of success more rapidly.

The experienced mechanic knows also that no man, however well versed in his trade, has a complete knowledge of the ramifications of machine shop practice, and that publications treating of it are of the greatest value as works of reference even to those men who have had many years of experience.

Periods of depression like this afford time for men engaged in shop work to fit themselves for future responsibilities by the study of mechanical books. When their shop is running on short time, instead of spending their spare hours unprofitably a part, at least, should be invested in study that will return them big dividends in future years.

It will pay employers also to encourage their men, and particularly their younger men, to spend their time in mechanical study. The cost of good books on machine shop practice is insignificant compared with the increase in earning power of men who acquire the information they contain. One of the greatest mistakes a man can make is to limit his purchases of educational books because his earnings have decreased. Real estate depreciates, stocks and bonds shrink in value, but knowledge is an investment that the owner can never lose out on.

The National Railroad Labor Agreement

EFFICIENCY in the operation of railroads, both in the traffic and in the machine shop divisions, is of vital importance to the industries of the country; but, as was pointed out in an editorial in the March number of MACHINERY, efficiency in the operating of railroad repair shops cannot be obtained unless railroad executives have complete control of the shop management. As long as the so-called "National Agreement" between the railroads and their employes is in force, there is no hope for real efficiency.

On September 20, 1919, when the railroads were still under government control, an agreement was made between the Director General of Railroads and the railroad workers, represented by the Railway Employes Department of the American Federation of Labor. This agreement specifies working rules for men in the Mechanical Section of the railroads.

Loss in Efficiency and Increased Expense

The American Association of Railway Executives early in the year appealed to the United States Railway Labor Wage Board for an abrogation of the "National Agreement," pointing out that its continuation would put many of the railroads of the country into bankruptcy. The Labor Board took no action, ruling that the agreement should remain in force until representatives of the employes had been heard.

The figures submitted by the railroad executives before the Labor Board showed that in 1917, before the Government took over the railroads, they employed 302,828 machinists, boilermakers, blacksmiths, electricians, and other shop employes and apprentices. In 1920 there were 443,774 such employes, an increase of 47 per cent; but it was also stated that the number of locomotives and cars maintained by this increased shop force in 1920 was but slightly greater than the number handled in 1917. The wages of railroad shop employes in 1917 were approximately $318,000,000, while in accordance with the wage scale approved last July by the Railway Labor Board, the annual payroll of shop employes is approximately $890,000,000, or an increase of 180 per cent as compared with 1917. Comment upon an increase of 47 per cent in personnel and 180 per cent in amount of wages paid for practically the same amount of work done is unnecessary.

Objectionable Rules in the "National Agreement"

The decreased efficiency and the increased cost are partially due to objectionable rules included in the "National Agreement on Working Conditions," according to which it is impossible for the railroads to operate their shops efficiently or in a manner similar to the operation of other industrial undertakings. In the following, some of these rules are quoted.

Rule 8—Employes regularly assigned to work on Sundays or holidays, or those called to take the place of such employes, will be allowed to complete the balance of the day unless released at their own request. . . .

Rule 9—Employes required to work during lunch period shall receive pay for one hour straight time and be allowed necessary time to procure lunch without loss of time. . . .

Rule 8 makes it necessary to pay the Sunday rate for the full eight hours if any work whatever is required by a shop man on a Sunday or holiday. Rule 9 pays the employe at three times his regular hourly rate if he is required to work during the twenty-minute lunch period, and still gives him the privilege of obtaining his lunch later on the company's time with full pay.

Rule 16—When an employe is required to fill the place of another employe receiving a higher rate of pay, he shall receive the higher rate; but if required to fill temporarily the place of another employe receiving a lower rate, his rate will not be changed.

Rule 18—When new jobs are created or vacancies occur in the respective crafts, the oldest employes in point of service shall, if sufficient ability is shown by trial, be given preference in filling such new jobs or any vacancies that may be desirable to them. All vacancies or new jobs created will be bulletined. Bulletins must be posted five days before vacancies are filled permanently.

Comment on Rule 16 is unnecessary. Rule 18 introduces many loopholes for inefficiency. It necessitates the granting of a try-out at new jobs to all men that are older in point of service, involving loss of time and inconvenience; it requires the posting of a bulletin on vacancies five days before they are filled, in order to solicit applications from men who rank on the seniority list and are therefore entitled to a try-out; and it involves a waste of time by shop employes who take the position that as Rule 18 requires the posting of bulletins, the men are entitled to read these bulletins during working hours. This rule has made the railroad shop bulletin board far more effective as a time-waster than the well-known tool-room window.

Rule 27—When it becomes necessary to reduce expenses, the force at any point or in any department or subdivision thereof shall be reduced, seniority as per Rule 31 to govern; the men affected to take the rate of the job to which they are assigned. Five days' notice will be given men affected before reduction is made, and lists will be furnished local committee.

In the restoration of forces, senior laid-off men will be given preference of re-employment . . . and shall be returned to their former position. . . .

No shop can be efficiently managed by seniority rules. Ability and efficiency only should be the guiding principles. Rules 18 and 27 destroy the initiative of the workman, because he will be rewarded by promotion only in case of seniority. The most capable men cannot be given a responsible job when a vacancy occurs, and the whole organization deteriorates.

In addition to the rules quoted, there are Rules 35 to 38 inclusive, dealing with complaints. These rules provide for the handling of all cases by the foreman, general foreman, master mechanic, or shop superintendent, each in their respective order in conjunction with the duly authorized local committee or their representative. They further provide for a long chain of general committees and higher railroad officials being brought into the case.

These rules cause an almost unbelievable loss of time and deprive the shop management entirely of their proper executive authority. Briefly interpreted, they mean that the foreman or other shop official cannot discharge an employe without first conferring with a committee of three of the fellow-workmen of his craft. Even the slightest complaint may be carried from one deciding authority to another until time has been wasted by all executives up to and including the president upon trivial matters. Furthermore, all the conferences are held during regular working hours without loss of time to the committee men who, being human, may be expected not to hurry the proceedings.

Fair-minded men will realize that unless some changes are made in the rules provided for by the "National Railroad Agreement," real efficiency can never be expected in the railroad shops, and until there is efficiency in the railroad shops there can be no real efficiency in the management of the railroads; nor can there be a reasonable adjustment of the present freight rates and passenger fares which, with a decrease in other costs, ought to be reduced.

The Problem of Taxation in the Industries

By GEORGE E. RANDLES, President, The Foote-Burt Co., Cleveland, Ohio

THE writer was much interested in the article "Taxation and the Industries" published in the March number of MACHINERY; those who have not read this article should secure a copy and give it careful study. It deals with a subject that is of the greatest importance to all manufacturers at the present time. Faulty methods of taxation work a great hardship on the industries, and may be the cause of serious depressions and difficulties; whereas carefully thought out methods of taxation may aid the industries in overcoming the difficulties now facing them because of the abnormal conditions caused by the war.

While the writer does not profess to be an expert on the subject of taxation, he believes that the method advocated by Mr. Price is sound, and that it would supersede at least the excess profits tax and probably some of the other taxes.

Advantages Gained by the Proposed Method

There does not appear to be anything wrong with the method proposed by Mr. Price involving the payment, as a tax, of a certain percentage of the total amount of the monthly payroll of each employer. On the other hand, anyone who will examine this method carefully can clearly see a number of advantages:

1. In taxing the payroll, there would be no danger of duplicate taxation; and whatever the article might be, no matter how many hands it passed through before reaching the final consumer, it would only carry its tax on the actual labor put into it, and this tax would not be duplicated.

2. A tax assessed on the payroll would immediately become an item of cost, and would enter into the cost of production just the same as the direct labor cost. There would never be any question as to what the tax would amount to, and inasmuch as it would not be duplicated and as there would be no inclination to add to the price to cover the possibility of a high tax, unknown in advance, the price to the consumer would be lower.

3. The collection of the tax would be extremely simple. There is nothing in connection with bookkeeping systems in the different industries easier to find and audit than the payrolls. A tax of this sort would therefore effect a large saving in its collection, and its prompt payment would be assured, which would be an advantage to the Government.

4. This method of taxation would eliminate the doubt as to what the excess profits tax is going to be, and the manufacturer would know from day to day exactly what this tax amounts to; he would know this as accurately as he would know what his payroll for that day amounted to.

5. This method of taxation would encourage thrift in many cases. The farmer, for instance, who is industrious and willing to work himself and to apply to his work modern farm machinery, would have an added advantage over the farmer who used more hired labor.

Manufacturers Should Give Attention to Taxation Problems

Since the method of taxation proposed by Theodore H. Price was first called to the attention of the writer, he has given it considerable thought and has discussed it with a number of manufacturers; while some objections were raised in the beginning of the discussion, these have all been met by the advantages, clearly in evidence, when the method is carefully examined. The writer has yet to find anyone who does not think that the principle is good and sound, and that it would cure many of the evils of our present system of taxation.

Manufacturers, therefore, should give earnest attention to this matter. Having decided that the method proposed by Mr. Price is superior to any other method that has been advocated, they should immediately write to their Senators and Congressmen at Washington, calling to their attention that Theodore H. Price, publisher of *Commerce and Finance*, New York, has devised a substitute for the excess profits tax that combines simplicity with equity. They should also point out that it is believed to be the best method for furthering the prosperity of the industries and the country as a whole, and that it would be the means of easily collecting the amount of money now obtained through the taxes that have proved objectionable and injurious.

The System of Taxation Should be Simple and Direct

When taxes are raised by complicated methods that are difficult for the layman to understand, as during the past few years, they are to a large extent paid under protest. Under the system of taxation now in force there is no way in which a manufacturer can obtain even a fair idea of what his taxes are going to be until he has closed his fiscal year, no matter how complete his accounting and cost system may be. His books may enable him to obtain a very accurate idea of how his business is running, but the excess profits tax is always one of mystery and complication, and in order to be sure that he is on the safe side, the manufacturer finds that it is absolutely necessary to increase prices accordingly, to take care of any uncertainties. On the other hand, the tax proposed by Mr. Price would prove a valuable means for stabilizing prices, and it would, above all things, encourage thrift in the conduct of business. It should not be considered wrong to make a legitimate profit.

More Discussion by Manufacturers on Taxation is Necessary

One of the reasons why we have such a complicated system of taxation is, perhaps, partly due to the fact that business men and manufacturers in general have not in the past taken a decided stand in advocating any particular form of taxation. They have accepted from Congress whatever Congress has handed to them. They have paid the tax grudgingly, because the basis for the collection of the tax was unreasonable and unscientific, but they have never unitedly tried to impress Congress with the fact that there is a method that would overcome the objections to the present system. The opportunity is now presented to do this.

Everyone to whom the writer has spoken about the proposed method has become quite enthusiastic when its advantages were fully understood. Perhaps there are some objections from a fiscal point of view, but if so, these remain to be pointed out. Meanwhile, let every manufacturer who approves of the method, who can see its advantages, who wants to substitute for the present conglomeration of taxation methods a simple, direct, and effective scheme, write immediately to his Senators and Congressman, telling them that before anything is done to institute new methods of taxing commerce and industries, they should carefully investigate Mr. Price's proposed method, and if no serious objections, not yet pointed out, are found, it should be embodied in the new taxation laws. The congressional committee which will handle new taxation bills should also be advised to consult Mr. Price, who undoubtedly is an authority on the subject, and the new Secretary of the Treasury would also do well to familiarize himself with the proposed method before making any recommendations for taxation.

Readjustment of Living Costs and Wages

The industrial depression through which the country has passed and from which it is gradually emerging has been the direct cause of the reductions that have taken place in prices, and therefore also makes necessary an adjustment in wages corresponding to the reduced cost of living. When prices went up, wages went up with them; and naturally, now that prices are coming down, wages must also be adjusted to the new level that prices will assume.

OFFICIAL statistics show that food prices in March, 1921, were 32 per cent below corresponding prices in March, 1920, and wholesale prices of all commodities were 35 per cent below the high peak last year. Prices of clothing have been reduced by even greater percentages; but rents and the cost of fuel have not been reduced, and will not be until wages in the building and mining industries have been materially reduced. Consequently, the total cost of living has not been reduced by quite as great percentages as food and clothing, but statistics covering all items that make up the necessities of life indicate that the actual cost of living has been reduced about 20 per cent, with indications that the reductions will be still greater as soon as retailers generally price their goods in accordance with wholesale prices, and building activity increases, forcing rents down.

Readjustment of Wage Scales

The attendant reductions in wages throughout the country have varied in general from 10 to 20 per cent in the metal-working industries. Reports received from various metal-working centers throughout the country are given in the following paragraphs. Many machine tool builders have not reduced wages at the present time and state that they will do so only when forced to as a matter of business necessity. They state that the wages paid in the machine shop industries generally have been considerably lower than those paid in the textile, printing, building, public utilities, mining, and railroad industries. They therefore believe that wages in the machine building industries should be maintained as far as possible, individual adjustments being made when required, while wages in the other lines mentioned naturally would have to be readjusted to a level where labor of the same class and skill would receive about the same compensation. Some machine tool builders have carefully studied their shop and manufacturing conditions, and report that they have been able to make some surprising reductions in costs without reducing wages. It is evident that in carrying out this policy they require the thorough cooperation of the workers, who must be willing to aid in the reduction of costs whenever possible.

The New England States

The reductions in wages in Connecticut generally vary from 10 to 20 per cent, although there are a number of cases where no reductions have been made. In Bridgeport, the average wage reduction has been about 15 per cent, and in most cases extra pay for over-time has been eliminated. On March 1, about 60 per cent of the men in the shops were employed as compared with the number at work when the shops were running at capacity. Some plants have reduced wages 20 per cent, and it is expected that further reductions will take place. Instances are reported where reductions have been as high as 35 per cent, and where men are being hired at a reduction from the previous rate of pay of from 35 to 50 per cent; but these are special cases. Wages were unusually high in Bridgeport during the war period, and hence the reductions there are more drastic. Manufacturers having advertised for help have found that men are willing to work for from 35 to 50 per cent less than they were paid in their previous employment.

In New Haven, the reductions in wages in the metal-working industries have varied from 10 to 20 per cent, being generally nearer 20 than 10 per cent. Toolmakers and highly skilled men have been reduced, on an average, 10 per cent, while machinists and less skilled workers have been reduced up to 20 per cent. The reductions have been made partly by eliminating bonuses formerly paid.

In New London, three of the large plants have made no reduction in wages except that new men are hired at reduced rates. One large plant has reduced wages 12½ per cent and another 20 per cent. The average reduction for machine shops in general in the New London districts is from 15 to 20 per cent. In New Britain the average reduction of wages has been about 20 per cent.

In Hartford, the wage reductions have averaged 15 per cent. Some factories are running short time with reduced forces, and are still paying the old wage rates, but it is generally believed that when business improves and it becomes necessary to run full time, a wage adjustment will be made. In practically all the shops the reductions are made individually. During the period of advancing wages, very few of the Hartford shops made "horizontal" increases, and in like manner, the reductions, when necessary, are not general, but are applied to the individual, so that some men in the same shops are reduced less than others. Many of the Hartford manufacturers are not in favor of great reductions in the wages of skilled mechanics, because toolmakers and machinists, for example, have not been as highly paid, in comparison, as men employed in some other trades during the last few years. The wage readjustment doubtless will create a greater difference between the skilled and the unskilled worker. It is estimated that about 20 to 25 per cent of the workers in Hartford are out of employment. In other Connecticut centers, reductions of from 10 to 20 per cent are generally reported. There is a general tendency to eliminate bonuses and extra rates for over-time.

In Providence there has been a reduction of approximately 10 per cent in the wages in the machine tool industry, with many factories working on short time—approximately one-half the regular working schedule. In a few instances there have been no reductions as yet, and some reductions have amounted to only 5 per cent. In Pawtucket, one large concern has not reduced its wages although there is very little business on hand, while other manufacturers have reduced wages up to 20 per cent. Several of the metal-working shops in Rhode Island are running only 25 per cent of normal, and some are entirely closed.

In Boston, new men are hired for at least 20 per cent less than the previous rate. In Springfield, Mass., reductions vary from 12½ to 15 per cent. In Worcester, Mass., some reductions of from 10 to 20 per cent have been made; but in many other of the Massachusetts cities and towns there have been but slight, if any, wage reductions. New men, however, are hired at a somewhat lower rate than formerly.

New York, New Jersey and Pennsylvania

In the vicinity of New York City, wage reductions in the metal-working field have varied from 10 to 20 per cent, although some machine tool builders have made no reductions. In Philadelphia, wage reductions in the metal-work-

ing plants have amounted to approximately 10 and 15 per cent, except in the machine tool plants, where no material reductions have been made. Special bonuses, however, have been eliminated. The reason that reductions have not been made in the machine tool plants is said to be that the wages did not increase anywhere nearly in proportion to the wage increases in other lines of metal manufacture. Several of the machine shops in Pittsburg and Erie have made reductions of from 10 to 20 per cent.

In Syracuse, wage reductions varying from 15 to 18 per cent have been made in some plants and from 8 to 12 per cent in other plants, while still others have made no reductions as yet. In Rochester, only two concerns are reported as having made reductions in wages, these reductions varying from 10 to 20 per cent. There are very few men being hired, but those engaged are hired at from 10 to 15 per cent less than prevailing wages six months ago.

Ohio and Indiana

In Cleveland and Toledo wage reductions range from 10 to 15 per cent for hourly rates for skilled workers, and from 15 to 20 per cent for unskilled labor. A 20 per cent reduction has also been made in many instances on piece-work. There are a very few concerns who have not reduced wages, but some of these expect to have to do so sooner or later. From Akron it is reported that the general wage reductions average from 10 to 25 per cent for all classes of labor, the reductions for skilled machinists being from 10 to 17½ per cent. In Canton, a general reduction in wages of from 12 to 20 per cent has been made, but this reduction has taken place not by reduced wages directly as much as by hiring new men at reduced rates. Most of the Canton manufacturers are trying to maintain the wages of the men remaining in their employ.

In Cincinnati there have not been any general wage reductions in the machine tool shops up to this time. There have been a few cases where a 10 per cent bonus previously paid has been discontinued, and in one case a flat 15 per cent reduction has been made, but these figures are not applicable to the majority of the plants. One foundry has reduced wages 10 per cent and another 15 per cent, while working hours have been increased in one case from 48 to 50 hours per week, and in another from 48 to 54 hours per week, the daily earnings being the same, which is equivalent to a wage reduction of from 4 to 12½ per cent. While the machine tool builders in Cincinnati have not up till now reduced wages in general, it is the consensus of opinion that if business conditions continue as they are at the present time in the machine tool field, some wage reductions will most likely become necessary.

In Springfield, Ohio, hourly rates have been reduced from 10 to 12½ per cent, and the extra rate for over-time after eight hours has been discontinued. If this is taken into account as well, the wage reductions would amount to from 20 to 22½ per cent. The reductions in foundries have been from 5 to 10 per cent, with piece-rate reductions of from 15 to 20 per cent. Wages of unskilled labor have been reduced from 20 to 30 per cent. In Hamilton, average reductions of 15 per cent have been made, with 20 per cent in some cases; in Dayton the reductions have been from 10 to 18 per cent.

In Indianapolis the wage adjustment has been met thus far, mainly by hiring new employes at reduced rates in cases where plants had to lay off their men due to the lack of business a few months ago. There has not as yet been any general wage reduction for old employes, except in a few instances. In Elkhart, wage reductions of from 10 to 25 per cent have been made, the average being about 20 per cent; from Kokomo, Ind., reductions of from 10 to 30 per cent are reported.

Michigan, Illinois and Wisconsin

In Detroit, wage reductions have varied from 10 to 25 per cent, and piece-rates have been reduced as much as 50 per cent. Wages in Detroit were abnormally high as compared with other industrial centers, and naturally the reductions for that reason had to be greater. In the Grand Rapids district, wages have been reduced on an average of 15 per cent in the metal-working trades.

In Chicago wage reductions have averaged from 15 to 25 per cent, and from Rockford it is reported that nearly all the factories have eliminated over-time rates for work over eight hours, which amounts substantially to a 10 per cent reduction in wages whenever the factories go back to a ten-hour basis. Several of the shops, in addition, have reduced wages from 10 to 20 per cent, and a number of those who have not yet done so will have to follow this example in order to meet prevailing lower selling prices. In Moline, no reductions have taken place as yet, but a 15 per cent reduction is contemplated, and new men are hired at considerably reduced rates.

In Milwaukee, no uniform reductions have been made, but the tendency is the same there as elsewhere.

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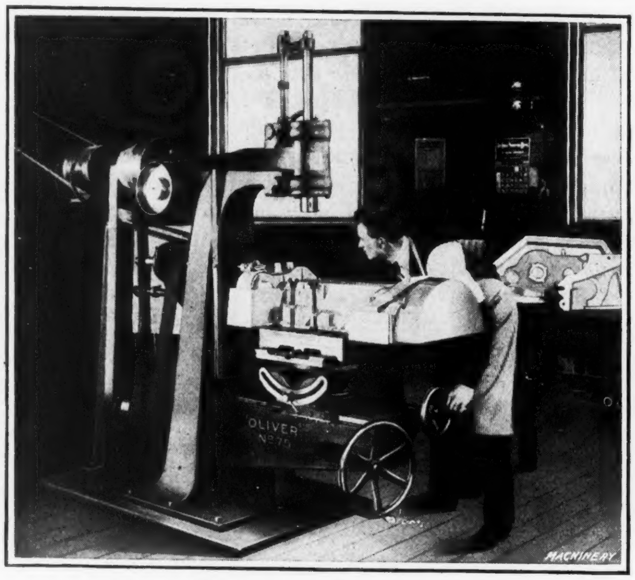
USING A WOOD PATTERN MILLING MACHINE ON METAL PATTERNS

A pattern milling machine originally intended for wooden patterns, of the general standard model built by the Oliver Machinery Co., Grand Rapids, Mich., is being used successfully for work on metal patterns. The illustration shows this machine as employed in the Racine Pattern Works, Racine, Wis., engaged in milling an aluminum pattern for an automobile crankcase of a four-cylinder truck engine. W. J. Simanek, proprietor of the Racine Pattern Works, states that in machining 400 sets of aluminum patterns for a well-known automobile manufacturer, he saved 66 2/3 per cent of the time formerly required by using the machine illustrated for metal milling. Regular milling cutters are used. Profiling and the milling of regular or irregular curves is accomplished at a rapid rate, and the machine has found particular application in the production of aluminum and other soft metal patterns and core-boxes. Being a woodworking machine and adapted for the high speeds for cutting in wood, it lends itself particularly well to the milling of patterns made from aluminum and other soft metals where high speed is possible and desirable.



Oliver Wood Pattern Milling Machine employed for machining Metal Patterns

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The tractor production in 1920 in the United States totalled 285,000. At the end of the year there were 325,000 tractors in use in the country. In 1921, it is expected that 150,000 Ford tractors will be made.

Better Relations between Machine Tool Manufacturer and Dealer

By OGDEN R. ADAMS, Rochester, New York

THERE are three distinct periods in the relationship between the manufacturer and the dealer depending upon the conditions in the trade. First, there is the period of prosperity, when the manufacturer has all the orders that he can handle—often in excess of his capacity for production. During that period there is a great temptation to neglect the dealer, but the wise man remembers that there is another day coming when the wheels of industry will turn in the other direction.

The second period is that of restlessness, when prosperity is taking wing and the manufacturer realizes that the dealer has some worth after all, and will prove a valuable asset when the business that used to flow toward him easily has ceased to flow and has to be coaxed through the neglected dealer's activities.

The third period is that of readjustment. I believe that we have reached this period and that manufacturers are taking a new view of things. War and strife are things of the past, but we are feeling the after effects and looking for a readjustment. Manufacturers are not only looking for a dealer who can produce results but are also expecting results. They realize that concentration and intensified effort count and that the dealer is in a position to produce results. But the manufacturer does not always realize that the dealer, having previously been neglected because he was not needed, must now do his missionary work all over again in order to establish himself once more in a secure position.

The Service Rendered by Dealers

The dealer is here to stay, and I believe that manufacturers realize that he is a necessary adjunct to a successful machine tool industry. The dealer covers his territory constantly with a staff of salesmen who come into close relationship with the customer. The dealer's local standing, acquaintances, and friendships obtained through years of hard work in the interests of his customers make his advice sought when machine tools are needed; and the dealer is entitled to a satisfactory return for his labors, enabling him to build up his business and strengthen it, which is also in the best interests of the manufacturer.

The wise manufacturer selects a strong representative, firm in the knowledge that such a dealer will make good. After all, the dealer's business is merely a branch of the manufacturer's organization. The dealer is constantly seeking to maintain his credit on a sound basis, and without doubt the manufacturer prefers, and ought to have, a representative who is well established in his territory and upon whom he can depend to maintain his business connections.

Loyalty between Manufacturer and Dealer

We now come to one of the main requirements in the establishment of better relations between manufacturers and dealers—loyalty. The manufacturer should strengthen the relationship formed by loyalty to, and faith in, his agent. He should stand back of the agent with cooperation, not only in regard to mechanical aid and advice, but with substantial trade discounts that will make it possible for the dealer to build up and maintain a business that will have a standing in the community. The manufacturer should not consider it unreasonable if the dealer receives remuneration sufficient to keep him and his salesmen in the proper frame of mind and to enable him to look with optimism into the future and make it worth while for him to exert himself to the utmost on the manufacturer's behalf. Such a dealer will be loyal to the manufacturer and will put enthusiasm into his work. He will see new points of interest in the manufacturer's product that he may have never noticed before. He will have a new incentive to boost the manufacturer's product when he knows that he is receiving cooperation and loyal backing in every respect.

It is a well-known fact that during the past few years the discounts allowed the dealers by manufacturers have not been sufficient to make the dealer able to "stick to his last"; as a result many dealers have been forced to sell used machinery in order to maintain the necessary margin of profit to keep their business going. I believe that dealers as a whole prefer to sell new machinery because it means sales that are much more satisfactory all around. If the dealer can realize enough on such sales to keep his business going along progressive lines, he would be glad to leave the dealing in used machinery to those who make a specialty of this class of work.

Concluding Remarks

The object of these paragraphs is to point out the true relationship between the manufacturer and the dealer, and to show that the dealer—the middleman—is needed. The manufacturer must realize that the dealer who is skilled in the art of selling, who knows his customers, and is industrious and always on the job in the local market, is necessary. In return for his efforts, he should receive credit, a living wage, confidence, and assistance. Active dealers spread all over the country will be able to turn in orders even when the market is dull.

I believe that the time has come when manufacturers in general will recognize the truth of the statement that I have made, and that better relations will be established between manufacturers and dealers. This will strengthen the whole machine tool industry, and will build up a selling organization that in some degree, at least, might be able to prevent the serious fluctuations to which the machine tool industry has always been subject.

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WORLD'S INDUSTRIAL EXHIBITION IN LONDON

Announcement has been made of an exhibition to be held at the Crystal Palace, London, from May to October, 1922, of the industries, products, sciences, and inventions of the leading manufacturing countries of the world. It will be on a cooperative basis, the capital being provided by the exhibitors and those otherwise connected with the exhibition, such as the guarantors of each nation who guarantee sufficient exhibits to warrant the preliminary work connected with the exhibition of their nations. The profits accruing from the various sources of revenue, such as contracts for advertising, catering, amusements, season tickets, gate receipts, etc., will be apportioned pro rata among the exhibitors in order to bring the cost of exhibiting to the lowest possible figure. Each country will elect its own exhibition committee which will be represented on the general committee. The management will be under the control of a committee representing exhibitors and guarantors.

The Machine Shop Industries in Holland

From MACHINERY'S Special Correspondent

Amsterdam, March 9

BEFORE considering the possibilities of importing American machine tools into Holland, it is necessary to review briefly the conditions of the domestic industry and markets in Holland during recent months. In pre-war years, there was no Dutch machine tool industry to speak of; but the impossibility of procuring machine tools during the war from the belligerent countries, and the difficulties of obtaining them from adjoining neutral countries, encouraged the starting of a number of enterprises for the building of lathes and grinding machines. Lack of suitable plants as well as of experience prevented any degree of success to be attained, either in quality or quantity. To the writer's knowledge no machine tools except lathes and grinding machines were built in Holland.

Industries Using Machine Tools

On the other hand, there are a number of industries in Holland that make use of machine tools, including some ten small factories for making woodworking tools, two factories for making cutlery—one in Amsterdam and one in Rotterdam—and a number of small shops making agricultural tools and implements; but the bulk of all the tools mentioned has always been imported from Germany. Dairy machinery and farm machinery have also been made successfully in a number of factories, which not only work for the home market, but which have also been able to develop an export trade to Belgium, Germany, Denmark, England, and even the United States; but the total product of these shops is small. In recent years, four plants making contractors' machinery have extended their works considerably, and are flourishing. They work principally for the trade in Holland, the Dutch West Indies, and South America. A considerable business has always been done by plants making machinery for the Java sugar cane industry. Three factories have recently been started for the making of automatic scales, and there is one building airplanes.

The machine building industry in Holland has never been highly specialized. Machinery of a special nature has largely been imported from Germany. According to the official statistics, during the last year before the war 60 per cent of the Dutch imports of steel and manufactures from steel came from Germany, 30 per cent from England, and 10 per cent from other countries. On account of the lack of imports during the war, the machine tool equipment in many shops became depleted, and there was a great shortage in machine tools for several years. It was expected that all this shortage could be filled by Germany. For some time, however, the inability of the German manufacturers to fill contracts, and the frequent changes in prices and uncertainty of delivery and quality made Dutch manufacturers hesitate to place their orders there.

The second-hand trade in machine tools which flourished during the war is now of much less importance. Most of the old machine tools are badly worn.

Future Market for Machine Tools

There is a general trend toward the introduction of American methods for efficient manufacturing, and it is believed that Holland would provide a good market for automatic and semi-automatic machinery, as many prominent men in the industrial field have spoken definitely on this subject of late and attracted considerable attention. Lessons have been learned by the war-time experience, and there is a general desire to increase production which in the past went at a rather slow pace. The demand for supplies and the unprecedented high wages caused by the high cost of living—which is perhaps on a higher level than in any other European country—have also made it necessary to increase the efficiency of labor by adopting improved machinery.

Effect of German Competition

At present, the industries of Holland are facing a depression. During the last weeks several plants have been closed owing to the inability of their product to compete with German imports. German manufacturers are now wide awake and are energetically attacking the problem of regaining their lost markets. Resolutions have been carried by the trade unions in Holland not to agree to reduced wages, and therefore manufacturers have no other choice than to close their plants or to look for more efficient methods and machinery to counterbalance the reduction in working hours effected by a new law for factories, which restricts the working hours to 45 per week, which cannot be exceeded without special license.

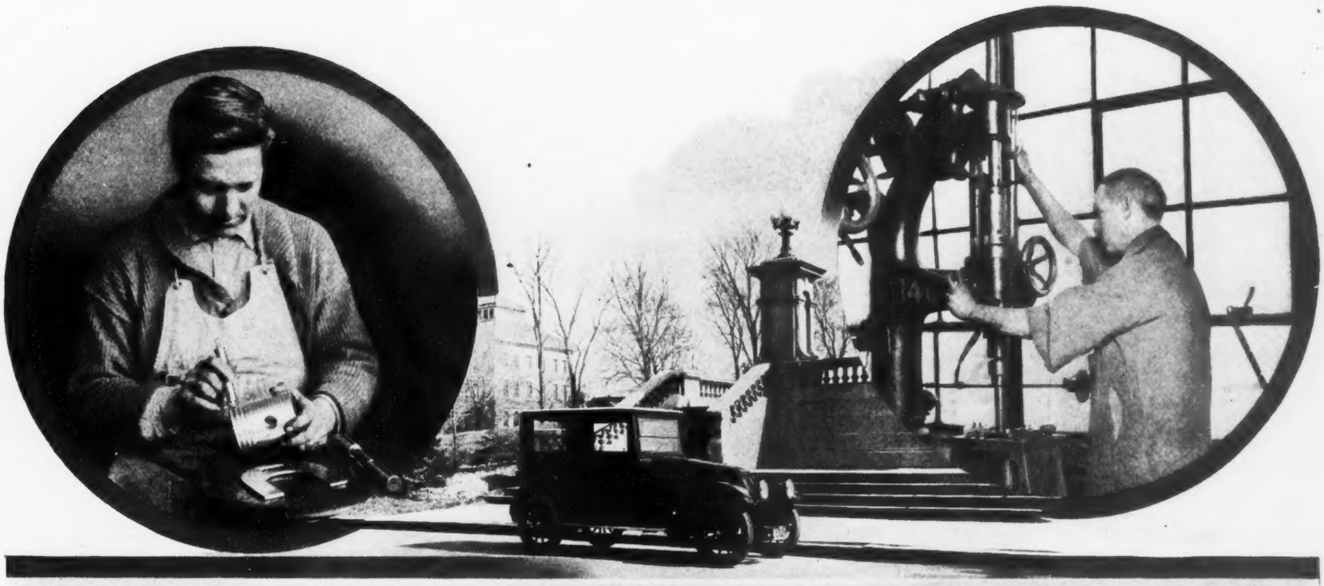
Efforts Made to Combat Foreign Competition

A committee has been formed by leading men in the commercial, industrial, educational, and financial fields to study the effects of the dumping of foreign-made goods in Holland. Their efforts, however, have not met with universal approval as, especially in the metal industries, the manufacturers have too much interest in obtaining cheap German supplies of raw materials, tools, and machinery; but in this field the shoe also pinches on the other foot, as structural iron work has been offered in Holland at a cheaper price per ton than Dutch manufacturers pay for raw material.

It is therefore evident that the only way to combat competition from abroad successfully is by adopting efficient machines and methods. At one time cheapness in machine tools was the only thing considered, and the German makers profited by it; now the manufacturer's mind is more open to the efficiency of American machines, tools and methods. Altogether, one might say that the conditions are favorable for American machine tools, but the question is how to overcome the difficult financial situation and to awaken the still somewhat dormant desire for better apparatus.

Obstacles to be Overcome in Creating a Demand for Modern Tools

It should not be forgotten that many of the metal industries in Holland have grown out of the handicrafts, and they were run for many years in a rather primitive manner. There is not a sufficient degree of specialization, and it is not an uncommon thing for the workman to change from one type of work to another several times a day; and as labor is not specialized, the machine tool equipment in most shops is not specialized either, but generally of a type that will serve all and any purpose. Of course there are exceptions, and the most successful enterprises are those that have been equipped for specialized manufacture; but the fact remains that the great majority of the average shops and factories lack suitable equipment and are working with inefficient methods. The greater number of these plants made good profits during the war, and they could buy improved equipment in order to increase their production and be able to compete with the aggressive foreign importer.



Central Control System in the Franklin Plant

System Employed by the H. H. Franklin Mfg. Co., for Regulating Output According to Demand, and for Controlling Manufacturing Operations by Mechanical Boards or Charts and a Pneumatically Operated Dispatch System

By FRANKLIN D. JONES

THE centralized system of controlling the rate of production and the successive order of manufacturing operations at the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where this system has been thoroughly tested for several years, serves two important functions in factory management: First, it insures that all the numerous parts of the Franklin car will be made in quantities consistent with the demand for these cars, and that production of the different lots of parts will be started and completed on dates, based not only upon the total number of cars required in a given time, but also upon the relative order of assembling the various units entering into the construction of a complete car. The other function of this centralized system, and one that is closely allied to the first, is to control the order of the work done by the men in the various departments of the plant.

This method of controlling production is part of a system of factory management that is based on the principle of the well-known Taylor system. An effort is made to determine the most efficient method of producing each part or unit, and this method is then adhered to instead of relying upon the judgment of different workmen and foremen as to the best practice. The order of all machining and assembling operations is carefully planned, and is then followed strictly unless subsequently a better way is revealed as the result of experience. In conjunction with this standardization of manufacturing practice, the tool equipment to use and the general operating conditions are also standardized.

Fig. 1. General View of Control Department, showing Some of the Boards that are used to control Successive Order of Manufacturing Operations and maintain Established Production Schedules

Function of Tool and Operation Department

The tool and operation department controls the design and construction of all special tools, jigs, fixtures, etc., and the selection of machines for different operations, as well as the exact order in which the work of machining or assembling is to be done, and production rates. The entire procedure is so systematized that the order for each job is not issued by the dispatch room (as described later) until all the necessary materials and tool equipment has been delivered to the machine, so that the workmen are not unnecessarily delayed.

The amount of work assigned to different departments is regulated by referring to data representing the production capacity of different groups of machines. The machines are grouped according to types, and the maximum capacity of each group is given as the total number of minutes required by any one group for producing the particular work for which these machines are adapted. For instance, in the "burden book" containing such data, the maximum capacity of a group of fifteen engine lathes may be given as 183 minutes. When assigning to these machines any of the operations for which they are regularly used, the total time for all the operations must not exceed 183 minutes, since that figure represents the maximum capacity. As the "burden book" contains such data for all the machine tool equipment, the tool and operation department has, in convenient form, a record that shows the relation between the work assigned and the producing capacities of the different types of machines.

One of the beneficial results of this system of shop management, which has been outlined very briefly, is that shop foremen are relieved of planning how work is to be done, the successive order of issuing or assigning work to different men in the department, and the selection of machines suitable for different operations. The foremen assist the tool and operation department in determining the standard practice at the time this practice is being originated, but after that the foremen have nothing to do with deciding what machines or tools are to be used, how the work is to be routed, or even what men are to do the work. This planning is all done beforehand, and is not changed unless by general consent of everyone responsible for the existing standard practice.

While much could be written on the details of the complete system of management, this article will deal chiefly with the semi-mechanical method of regulating production in the different departments.

The Control Boards or Mechanical Charts

The general purpose of the control boards is to determine the successive order in which different jobs are given to workmen, and at the same time to show readily when work on different lots and parts should be started and finished. First, it is necessary to establish a schedule of production so that the equipment to be described can be utilized for showing just when the numerous parts are required in order to maintain this predetermined schedule. This schedule will be referred to later. Fig. 1 shows a general view of the control boards. Each board or chart is composed of narrow horizontal strips *A*, Fig. 2, mounted in slides, which are attached to vertical steel cables. These cables pass over pulleys carried by a shaft at the top of the framework, so that the entire board or chart formed by the numerous horizontal strips can be raised or lowered to any convenient position by turning handle *B*, which revolves the shaft carrying the cable pulleys.

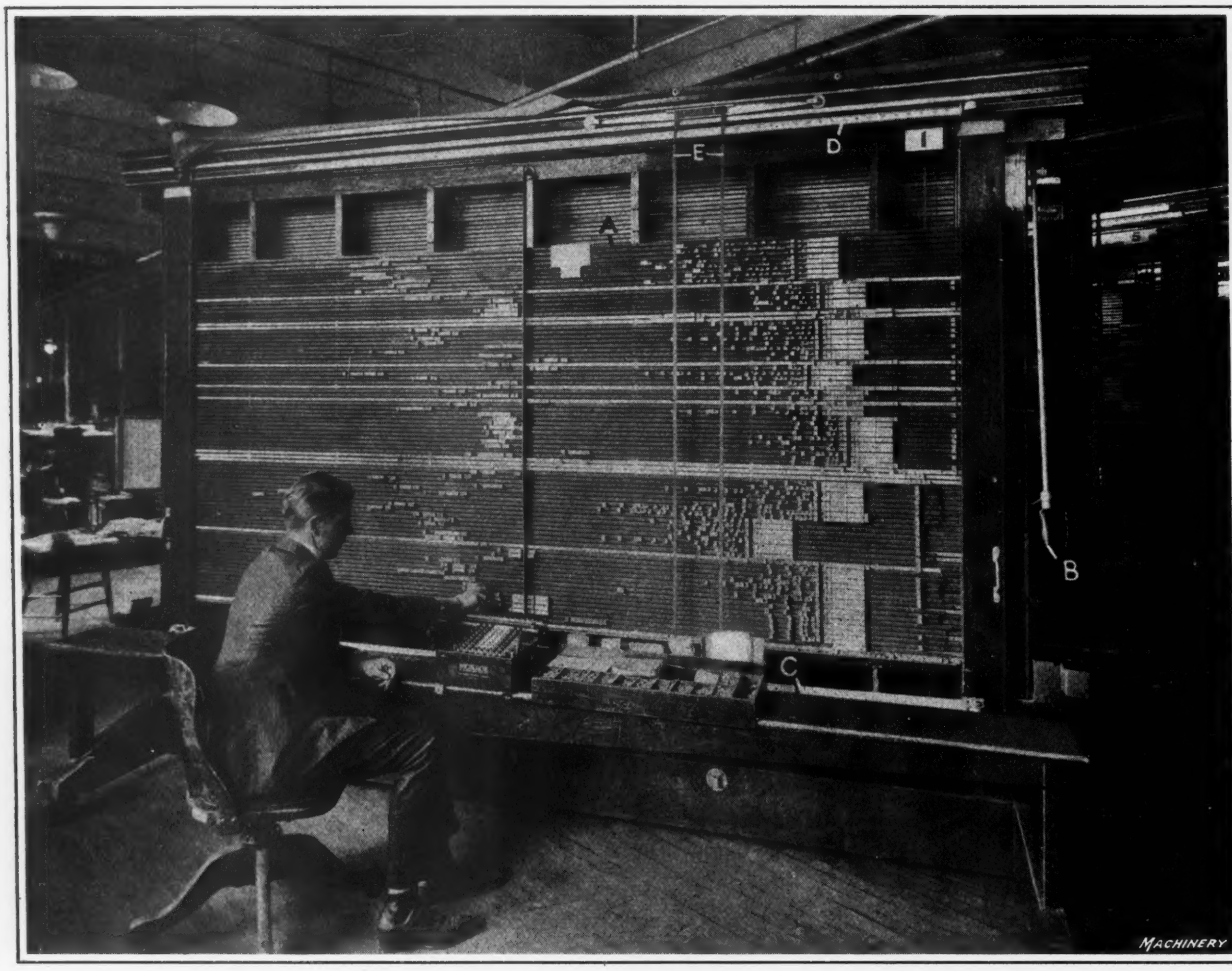


Fig. 2. One of the Control Boards. These Boards show graphically when and where Operations on Different Parts should be started, and the Relation between Actual and Desired Rates of Production

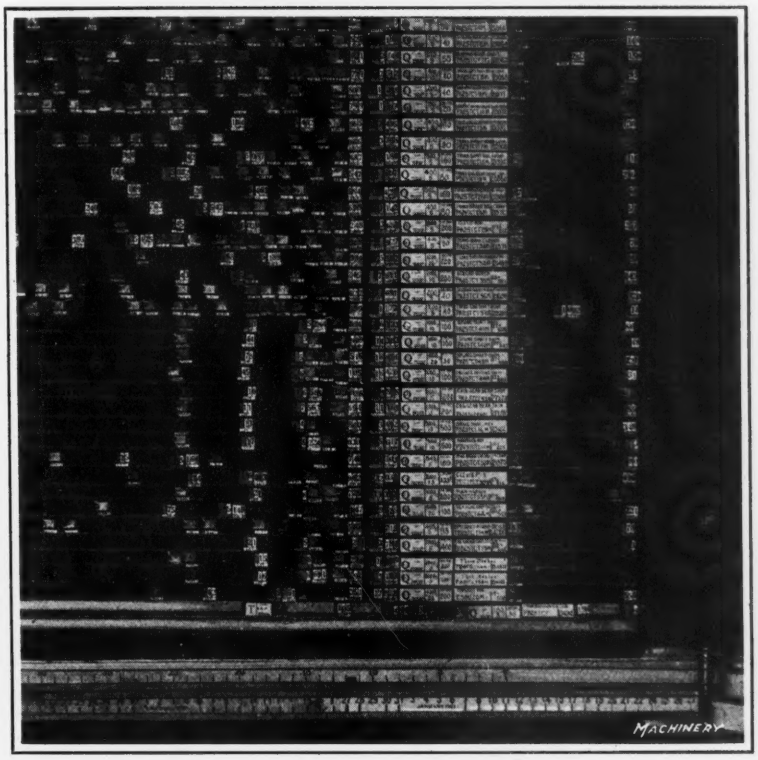


Fig. 3. Small Section of a Control Board

Each part manufactured in the plant (not purchased) is represented by one of these horizontal strips, which is simply a graphic representation of the order of operations, and is not changed until the methods of making the part are changed. White strips indicate assembling operations. On the face of each strip there are a number of small blocks, which are removable but are securely held in place by steel clips or cages into which the blocks fit snugly. These blocks indicate different steps or operations connected with the production of the part represented by the horizontal strip to which the blocks are attached. For instance, one block of the series may indicate the ordering of raw materials; another, the issuing of the materials to the shop; a third, preliminary inspection of materials; a fourth, some kind of milling operation; a fifth, surface grinding, etc. The successive order of the blocks on the horizontal strip corresponds to the successive order of performing the different operations.

One of the important functions of the control board is to determine when the manufacture of each lot of parts is to be started, so that the various units are not completed too late (thus retarding work in other departments) or too soon, but at the right time and in the correct relative order as determined by the manufacturing requirements relative to the finished product; therefore, the element of time must be considered. Each of the horizontal strips previously referred to is, in a sense, a scale, and every half inch space on it, as measured from a zero position located at the right-hand side of each control board, corresponds to a working day. Consequently, the distance between this zero position and any block on the horizontal strip, shows how many days before the completion of a given lot of parts, the work must be started on that particular part which the strip represents. For example, if the block indicating a grinding operation on the crankshafts were seven feet to the left of the zero mark, this longitudinal position on the strip would show that this particular grinding operation on the lot of crankshafts should be started 168 days before the date set for the completion of the lot of cars, because seven feet, or eighty-four inches, equals 168 half-inch spaces, and each of these represents a working day.

Experience in the manufacture of cars has demonstrated at just what stage of the work the manufacture of each lot of parts should be started, and when they should be finished, ready for assembling. By referring to Fig. 2 it will be seen that some of the horizontal rows of blocks extend much further to the left than others, which indicates that the production of these parts must be started sooner. In order

Fig. 4. Boxes in Dispatch Room, representing Groups of Machines and containing Cards that are sent to Different Departments for controlling Order of Operations

to have a complete record of the manufacturing requirements for each part produced in the plant, sixteen boards or charts similar to the one shown are necessary. These boards regulate the production of the numerous parts, so that each lot is ready at the right time, thus avoiding interference and needless delay. Certain time standards have been established in addition to the actual manufacturing time to allow for such factors as the lapse of time between issuing the requisition and delivery of the material, the time required for moving unfinished parts from one machine or department to another, the maximum time finished parts are to remain in storage, and whatever additional allowances are necessary.

The information given on each horizontal strip of a control board includes the name of the part, the drawing number, the standard number of parts in a lot (which corresponds to the number moved from one machine or operation to another), and the total number of cars for which parts have been finished at a machine, vise, or other place where work is done. If the number 100 appears in connection with the grinding operation on the cylinders, this does not mean that 100 cylinders have been ground, but enough cylinders for 100 cars, or 600 cylinders, since there are six cylinders for each motor. In order to provide means of readily changing these numbers, three rectangular shaped blocks with a figure on the face of each may be placed side by side in the cage; hence, if the number does not contain more than three figures, a single cage may be used. For larger numbers two of the cages are placed together, and blank blocks are inserted where there are no figures. Below these numbers another block is inserted horizontally, and this has marked on it the symbol of the machine, vise, or other place where work is done, together with the operation number.

A balanced straightedge (the top of which is just visible at *C*), extends across the board and is suspended on cords, so that it can be raised or lowered. On this straightedge there are two tapes placed one above the other, as shown at the lower part of Fig. 3 which illustrates a small section of one of the boards. The upper tape is simply a scale having half-inch graduations. Every fifth graduation is numbered, the numbers increasing toward the left. When this tape is placed beside one of the horizontal strips, it shows how many working days ahead of the final completion date any operation must be started. For instance, if the cage and the blocks representing a turning operation on a transmission shaft is opposite No. 115 on the work-day tape, this shows that the turning of these shafts should be started 115 days ahead of the time scheduled for finishing this lot of cars, to insure turning all of the shafts required as soon as they are needed. Just below the work-day tape there is a calendar tape, which is graduated according to the working days in each month and is read from left to right. To illustrate the use of this tape, suppose the graduation for January 14, 1921, is just below the zero position of the board, which, as will be recalled is on the right-hand side; this shows that the cars in this particular lot are scheduled for completion on or before the date mentioned. By placing this calendar tape opposite any strip on the board, it shows the dates for ordering materials, when the materials should be received, and also the dates for starting all the different manufacturing operations.

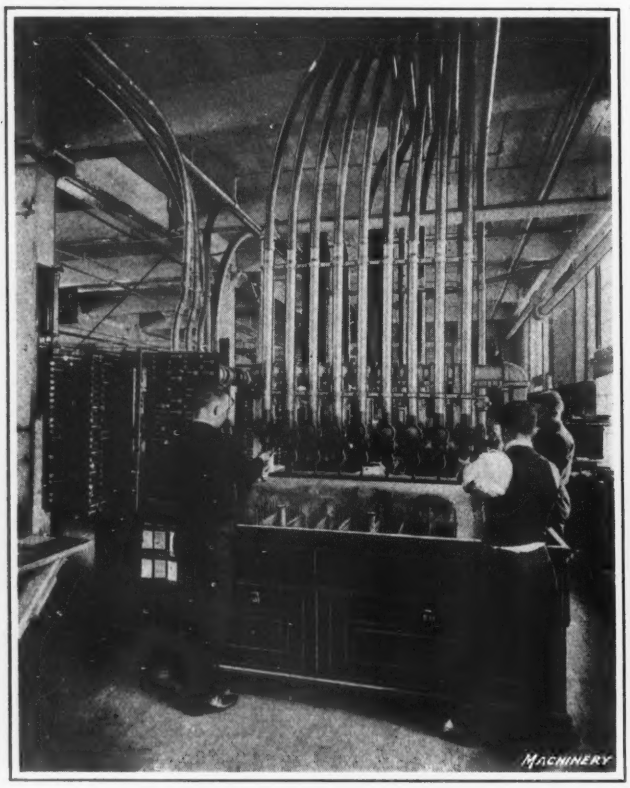


Fig. 5. Dispatching Job Cards to Different Departments through Pneumatic Tubes located in the Dispatch Room near the Boxes that are shown in Fig. 4

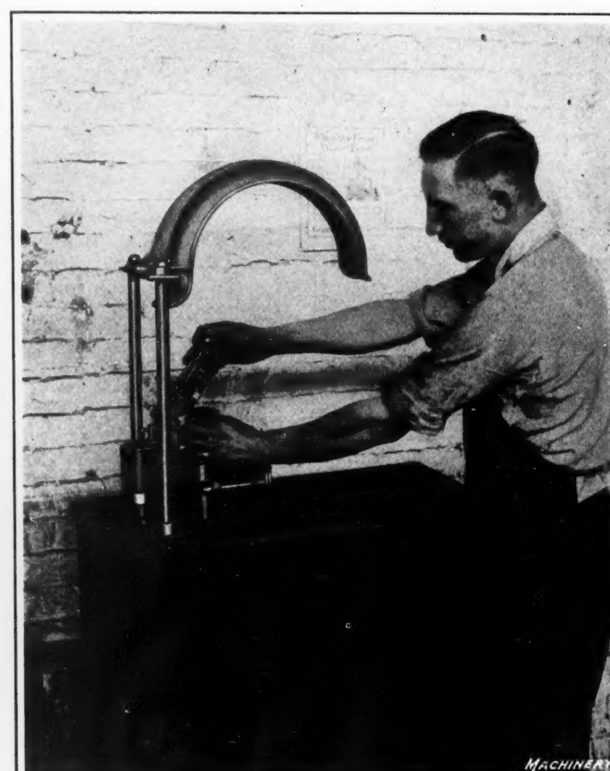


Fig. 6. Workman sending back a Card after completing the Work prescribed. The Card for the Next Job is immediately sent to him from the Dispatch Room

How Production is Regulated According to a Predetermined Schedule

It is evident from what has preceded that this system of controlling various manufacturing operations is based primarily upon the number of finished cars required at different periods. The management, in attempting to determine approximately the number of cars to be manufactured, relies upon past experience, sales records, and the general tendency of the market. This predetermined schedule must take into account, not only the total output for the year, but also changes at different seasons of the year, the trend of sales from one year to the next, and the popularity of one model as compared with another. In other words, it is necessary to consider every factor that may affect the demand sufficiently to require consideration in connection with manufacturing.

The cars are manufactured in lots or numbers representing a certain fractional part of the output for a season. These lots and the time allowed for completing each lot are

changed as demand changes. In order to have all of the numerous parts produced in accordance with the schedule decided upon for the completed cars, this schedule is laid out in the form of a graduated tape which is located at the top of the control board, as shown at *D*, Fig. 2. Opposite the graduation marks on this tape there are numbers which increase from right to left from zero up to the total number of cars in a lot. Now, if this total number is, say, 4000, and if this lot is to be completed in, say, 100 days, the numbers from zero to 4000 on the schedule tape will extend a distance of 50 inches, because according to the scale of the control board, one working day equals one-half inch. This schedule tape is advanced to the right one-half inch every working day by winding it on a reel. As the numbers above any position on the board increase due to this daily movement toward the right, these numbers show whether the parts represented by the blocks on each strip are being finished at a rate that conforms to the rate on the schedule tape.

To illustrate, if the number posted in that cage representing the finish-grinding of crankshafts is 1850 and the number on the schedule tape directly above is 1800, this shows that the finish-grinding of crankshafts is ahead of the schedule. On the contrary, if the number on the schedule tape is, say, 1900 this would indicate that this particular grinding operation is behind the schedule. In order to compare readily the production figures posted in the different cages, with the schedule tape, a vertical straightedge *E* is used. This has rollers which run on a track on the top of the board, so that it can be shifted easily.

Dispatching Orders to Different Departments through Pneumatic Tubes

When the time arrives for starting the manufacturing operations on any given lot of parts, as determined by the control board, the orders are issued to various departments through a central dispatch room which is near the control boards. In this dispatch room there are various compartments and boxes, arranged as shown in Fig. 4 which illustrates part of this equipment. These compartments and boxes represent groups or types of machines, and contain the cards that are issued to these machines for controlling the manufacturing operations. When the control board shows that a certain operation must be started, a job card and other cards to provide for movement of materials and inspection of work are filled out and placed in whatever dispatch room box represents the machine to be used. One of these cards is sent to the "move-man" through a pneumatic tube, and this man delivers to the machine indicated whatever materials, special tools, etc., are specified; then the workman's job card and another card used in connection with inspection are taken from the boxes in the dispatch room and the time is stamped on them by an electrically controlled time stamp, which may be seen at the right-hand end of the rack illustrated in Fig. 4.

The job card and whatever instructions are necessary is next sent to the man who is to do the work, and the inspection card remains in the dispatch room box. When the work specified on a particular job card is finished, this card is sent back to the dispatch room by the workman. The time is again stamped on both the job and inspection cards, and the "move-man" is notified by the receipt of another card to transfer the work to the place where the next operation is to be performed. Provision is made in connection with this system for adequate inspection of the work whenever this is considered advisable after any machining or other operation. Just as soon as the work called for on any job card has been completed, a new job card is issued to this man as soon as he returns the preceding one representing the finished work.

By sending these cards to the different workmen and to the various departments, in the proper order, the movement of any part from one machine to another or from one department to another is controlled from the dispatch room, which, in turn, is governed by the control boards. Fig. 5 is a view in the dispatch room and shows the terminals of some of the pneumatic tubes through which the cards are sent to different parts of the factory. The cards are placed in leather carriers which travel rapidly to their respective destinations, the system being operated by compressed air. Below the terminal of each tube there is a row of vertical pegs upon which the inverted carriers are placed during the short interval between the receipt of a card from the shop and the sending of a new one representing the next job for that particular machine or other place.

The shop terminal of one of these tubes is illustrated in Fig. 6, which shows a workman about to send back a carrier containing a card issued for work that has been completed. In a very short time the card for the next job is returned, the man waiting at the terminal until it arrives. By means of this system hundreds of manufacturing operations are controlled every day, and instead of depending upon the judgment of different foremen regarding the proper machines to use, the order of assigning work, and the general method of procedure, the entire manufacturing practice is based upon a plan which has been developed just as carefully as the design of the Franklin car.

* * *

UNIT TOOLING FOR FLAT TURRET LATHES

By "unit tooling" is meant the locating of an entire series of tools used for machining a part, in permanent relation to each other. This is accomplished by providing a special cast-iron arm, or multiple tool-holder which is fastened to the flat turret of a turret lathe by means of machine screws. One of these multiple tool-holders is shown attached to the turret of a Jones & Lamson flat turret lathe in Fig. 1. It will be seen that this casting is provided with several bosses in which the tools are fastened by means of set-screws. While the advantage derived by employing this special multiple tool-holder is obvious, it is also evident that the employment of such a unit tooling arrangement is a production expedient only when quantities of work of a standard nature are handled in the shop. The expense of making such a tool-holder would not be warranted for special classes of work on which no repetition orders are likely to be received.

After a job has once been set up, no further work is required of the machine setter. The operator, when completing a job, sees to it that all tools are ground and reset in their respective positions, so that after the job is finished and the tool-holder removed from the turret, the established relationship of each tool to the surfaces of the job for which it was designed is maintained. As an illustration of how this multiple tool-holder is employed on production work, a description of the entire machining procedure of a cream separator bowl top will be given. This work is performed in the shops of the De Laval Separator Co. at Poughkeepsie, N. Y. Fig. 1 illustrates the operations on the exterior surfaces of the bowl top, while Fig. 2 is a tooling lay-out of the operations on the interior.

The forging is first mounted on the faceplate of the lathe, being located by a U-washer and screw which threads into the end of an arbor. The first operation is performed with the two tools designated as 1 and 2. The operation consists of rough-facing the flange at the bottom of the forging and the shoulder near the neck. Reference should also be made to the general outline of this shell shown in dotted lines in Fig. 2, while following the machining operations on the exterior of the work. Operation 2 is performed after the U-washer and bolt have been removed as a holding means, and superseded by three faceplate clamps which provide for driving the bowl top from the flange. The second operation is performed with tool 2 which was also used in the first

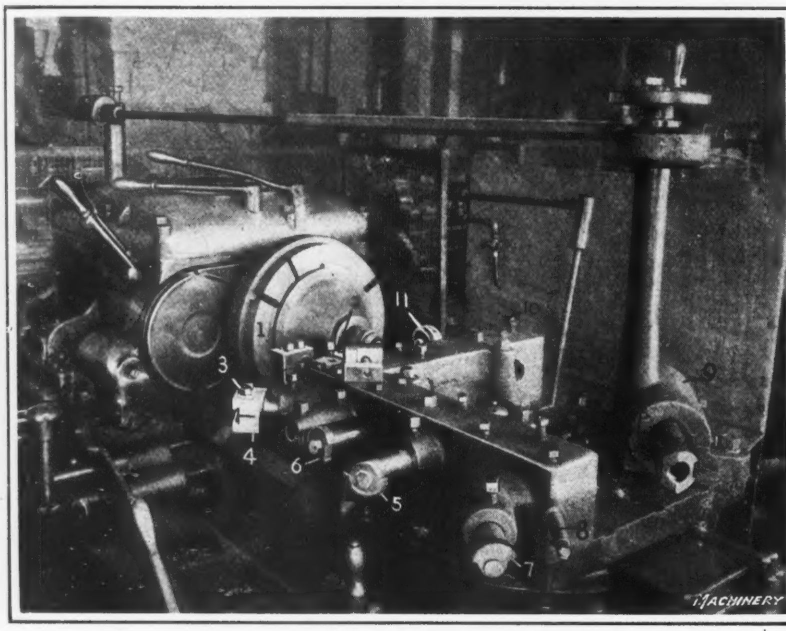


Fig. 1. Turret Lathe equipped with Multiple Tool-holder for machining Exterior Surfaces of Cream Separator Bowls

operation, and consists of rough-facing the end of the forging. Operations 3 and 4 consist of rough-turning the neck and the surface above the taper, the tools being held in the tool-holder indicated in Fig. 1 by these numbers. Operation 5 consists of finish-facing the end, the neck diameter, and the top shoulder using the circular tool-holder in the position indicated by the number 5 in the illustration.

The tool used in the next operation and its location in the multiple tool-holder are indicated by the number 6. This is a forming tool used to recess a groove on the neck of the forging. This groove may be faintly seen in the illustration. The tool designated by the number 7 forms the radius which joins the angular surface with the shoulder below the neck. Operation 8 is that of boring the end hole with the tool-holder in the boring-bar. The exterior of the forging is now finished from the beginning of the taper up, and the remaining operations are those on the taper and the flange.

The faceplate clamps are next removed and replaced with the washer and bolt used in the performance of the first operation. During the ninth operation, which consists of roughing and finishing the taper of the bowl top, the standard Jones & Lamson angular attachment is employed. This attachment is indicated by the number 9, but it will be readily understood that it is impossible to show the tool, since before performing the operation the position of the turret is changed to bring the tool into contact with the work. In this connection attention is called to the construction of the connecting-rod used on this machine. Instead of a one-piece rod, which is the usual construction, a telescopic connection is made with the driving gear, thus overcoming the trouble sometimes experienced by permitting this rod to extend considerably beyond the machine and interfere with the available space, such for example as in alleyways. Operation 10 consists of rough- and finish-turning the outside of the flange, and although the tool cannot be seen, its location is indicated by the number 10. The number 11 represents the circular forming tool used in the last operation, which is that of finishing the top of the flange and forming the radius connecting it with the taper of the forging. It requires two hours to perform these operations.

Design of Multiple Tool-holder Used in Machining the Interior of the Forging

The tooling lay-out illustrated in Fig. 2 needs but little explanation. The position of the work relative to the tools during each operation is indicated by dotted lines, and the surfaces finished at each station are indicated by heavy lines. The numerals appearing on the illustration are the same as the operation numbers, so that in referring to the work performed, the mere enumeration of the operations should be sufficient. It will be seen that the cast-iron arm *A* is of the same general design and size as that shown in Fig. 1, and that the regular Jones & Lamson angular attachment *B* is also employed in the machining of the forgings. The operations performed are as follows: (1) Drill hole in end of neck, using 1¾-inch drill; this drill must be removed during operations 2, 3, and 12. (2) Rough-turn. (3) Rough-face two surfaces. (4) Counterbore interior of neck, using square-point drill. (5) Counterbore, using tool-holder and single cutter. (6) Rough-bore interior of neck with regular boring-bar; (7) Finish-face the bottom, using a circular tool. (8) Machine the interior walls with the angle attachment. (9) and (10) Finish-turn and finish-face the surfaces indicated. (11) Finish-bore the neck and finish-face the bottom of the bowl in the neck, and the shoulder surfaces indicated. (12) Recess the flange. It will be remembered that in this operation the drill used in Operation 1 is removed so as not to interfere with the position of the work.

* * *

The official bulletin of the Interstate Commerce Commission, in a statistical summary covering a period of three months during 1920, states that the payroll of employés of railroads for that period absorbed 57.4 per cent of the gross earnings, this being the highest ratio of cost of railway labor on record. The average yearly pay of employes was $1600 a year in 1920, and at the present time it is over $1800 a year. This is about 110 per cent above the yearly average in 1915.

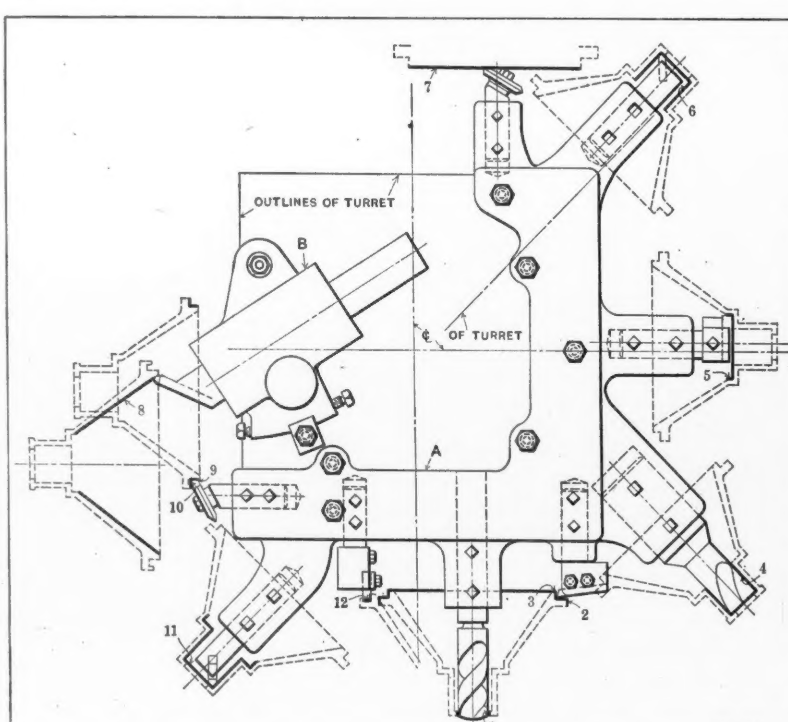
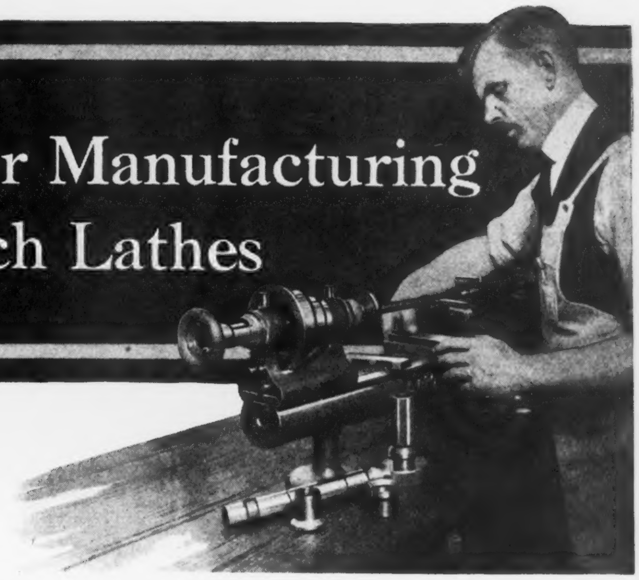


Fig. 2. Tooling Lay-out, showing Tools employed to machine the Interior Surfaces of Cream Separator Bowls

Tools and Methods for Manufacturing Precision Bench Lathes



Practice of the S. A. Potter Tool & Machine Works, New York City, in the Manufacture of Bench Lathes—Second of Two Articles

THE first installment of this article, which was published in the March number of MACHINERY, described the finishing of the beds of the Potter precision bench lathes, machining the headstock, carburizing and casehardening, and the machining operations on the lathe spindle. The present installment, which concludes the article, describes the grinding of the spindle bearings, cone, and collet chuck, the machining and graduating operations on the index-slide, and the painting and inspecting of the assembled lathes.

Grinding Spindle Bearings and Cone

In finishing the spindle bearings *E* and *F* (see Fig. 1 in the March number) the means used in performing the grinding operation on the work are worthy of mention. After being produced on the Gridley automatics and hardened, a preliminary grinding operation is performed on the small diameter. During this operation the work is held against the head of the grinding machine by a long draw-rod extending through the spindle, and protruding beyond the end of the work. The projecting end of the rod is straddle-milled so that by means of a slotted washer which fits the milled end of the rod, the bearings may be held against the work-head. This method of location is preferable to using a mandrel, since the draw-rod does not contact with the bore of the bearing, and consequently the bearing is sprung by forcing it on a mandrel, and distorted when removed after being ground. The preliminary operation is that of taper-grinding the body of the bearing to provide a more accurate means of locating it during the remaining grinding operations. This taper is a wringing fit in a holder which is attached to the grinding machine head during the operation of grinding the bore. It is apparent that if the preliminary taper-grinding operation were not performed, the exterior straight surface could not be employed to chuck the work by wringing it into a holder, without destroying the concentricity of the exterior and interior surfaces of the bearing. After the bore has been ground, the work is mounted on a straight arbor and the temporary tapered exterior is reground straight and concentric with the interior.

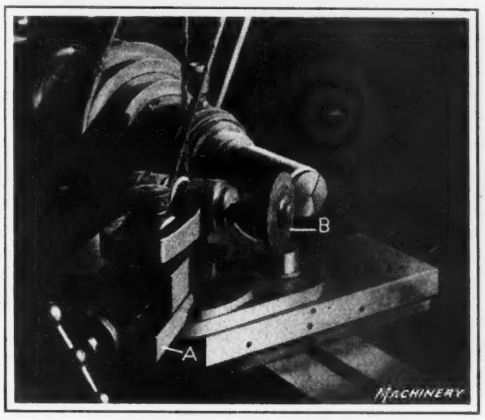


Fig. 9. Bench Lathe with Swiveling Slide for Grinding-wheel Head

In the grinding operations performed on the cone, another interesting manufacturing kink is introduced. Two grinding operations are performed, one on the bevel surface *R* of the head (see Fig. 1) and one on the tapered body, and in these operations two grinding machines are used. The work is mounted on a mandrel and is not removed until both these surfaces are finish-ground. As soon as one grinding operation is finished, the mandrel is removed and placed in the other machine for the second grinding operation. By this means, the concentricity of the two tapered surfaces is established with a much greater degree of certainty than

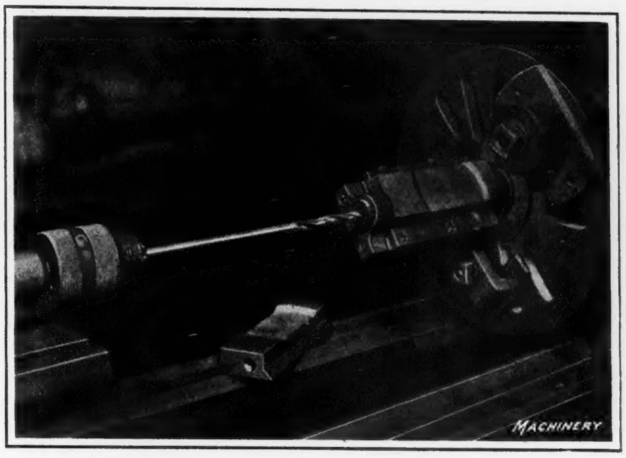


Fig. 10. Fixture used for drilling the Feed-screw Hole in the Index-slide

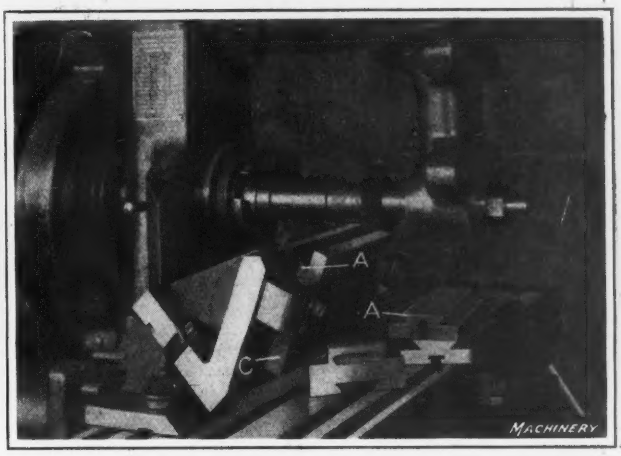


Fig. 11. Fixture for holding Bottom Slide during the Milling Operation on the Dovetail

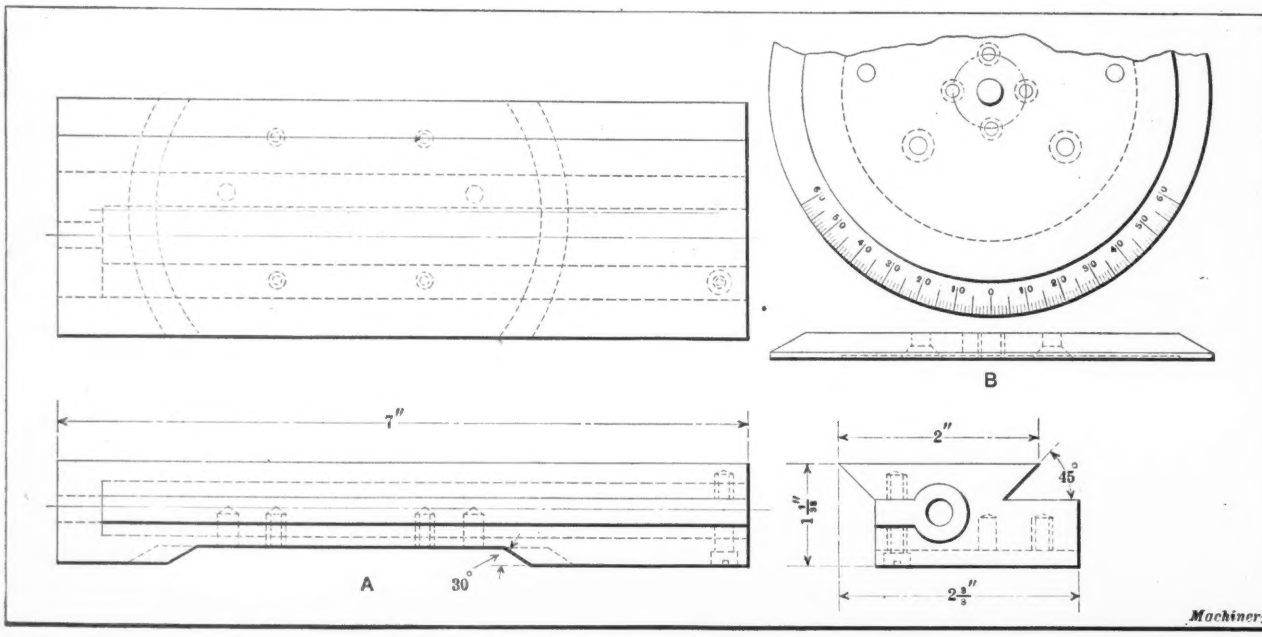


Fig. 12. Index-slide and Graduated Sector attached to its Under Surface

if the work were removed from the mandrel after each grinding operation. The time that would ordinarily be consumed in removing the work from the mandrel is also saved, and although two machines are used, the operations are of short duration so the machines are not tied up for any considerable length of time, and one operator can easily attend to both grinders. It requires ten minutes to complete this operation on one cone.

Grinding Exterior of Collet Chucks

The manufacture of the collet chucks is different in some respects from usual manufacturing procedure. The preliminary operations, from the time the collets leave the Cleveland automatic screw machine up to and including the hardening operation, are in accordance with regular manufacturing methods, but in the finishing the practice is followed of grinding the exterior, which is unusual. In a piece of work such as a spring collet, there is obviously a great possibility of distortion due to hardening, which cannot be corrected by the usual method of finishing the exterior by polishing. The practice of grinding the outside also enables the interior to be more accurately ground by chucking the collets from the outside, and, in addition, gives a greater degree of concentricity to the work.

One other factor to be considered in this connection is the human element, for polishing is a much more tiring operation than grinding, and if the best results are to be obtained conscientious effort on the part of the workmen is essential. The nature of the work does not encourage the workmen in this direction, so that on the whole, greater economy is obtained, and at the same time a more uniform product is realized by employing the grinding method. This grinding operation is performed on a Landis No. 2 universal grinder. During grinding operations on the rounded ends of the collet (see Fig. 9) a regular Potter bench lathe is used, provided with a swiveling compound rest *A* so that the wheel *B* may be swung on the same radius as that of the end curvature. A 70-grain alundum wheel is used in this operation. The illustration clearly shows the simple method provided for swiveling the compound rest as the end of the work is being ground. The production time is fifty collets per hour.

Operations on the Compound Slide Rest

The compound rest of the Potter lathe is composed of four slides, as follows: The bottom slide, which rests on the top surfaces of the bed; the lower cross-slide with graduated feed-screw for swiveling the index-slide; the index-slide *A*, Fig. 12, which is of similar construction to the lower cross-slide and to which the sector plate *B* is attached; and a top

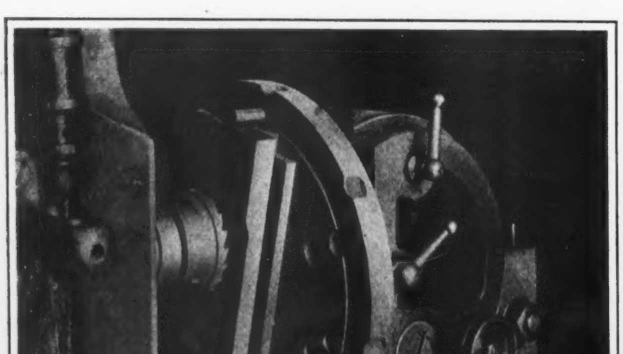


Fig. 13. Milling Graduated Disk Recess in Index-slide

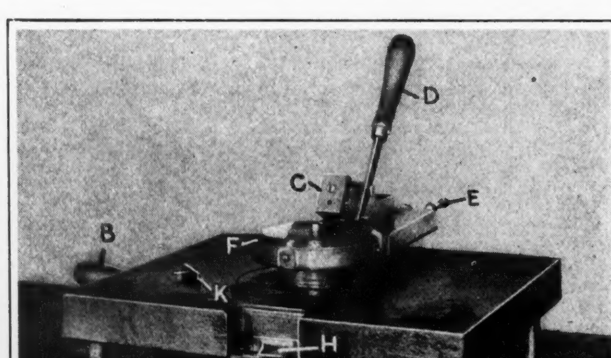


Fig. 14. Fixture used in graduating the Sector Plate

slide which fits the top of the index-slide and is operated by a nut on the index-slide feed-screw. This slide contains the T-slot in which the toolpost is mounted.

The holes through which the feed-screws for the lower cross-slide and index-slide are operated are drilled by a rather interesting tooling arrangement. A special fixture is used, which is attached to the faceplate of a Prentiss lathe as illustrated in Fig. 10, so that the work revolves while the drill is held stationary in the tailstock as it is being fed into the work. This insures a straighter hole than could be obtained if the holes were drilled in the usual manner with the tool revolving. This hole is not drilled all the way through either slide; on the lower slide it is blind, while on the index-slide as shown in Fig. 12, a hole is drilled in to meet it from the opposite end, in which the pilot of the operating screw has its bearing. The tendency of the drill to "whip" or run out at the end is overcome with this arrangement, and so a more accurate hole is obtained. The fixture shown in the illustration is set up for performing the drilling operation in the index-slide, and a piece of work is shown on the lathe bed. The floor-to-floor production time is ten minutes per casting.

On the under side of the index-slide, Fig. 12, there is a recess which fits over the graduated disk *B*. This recess is finish-milled by mounting the slide on the faceplate of a dividing head as shown in Fig. 13, and using an end-mill having angular ends to conform to the 30-degree beveled surface of the disk which is assembled in the recess. Then by revolving the dividing head, the recess is generated, the center of the end-mill being located eccentrically in relation to the center of the recess, so that one complete revolution of the index-head results in finishing the operation. The time required, including loading and unloading the work, is five minutes per piece.

By referring to the illustration Fig. 11, it will be seen that there is a dovetail *A* on the bottom slide, which fits into a corresponding groove on the lower cross-slide. The angle of these surfaces is 45 degrees, and the work is set up in the manner shown for the milling operation on the dovetail. The machine used is a No. 2 Kempsmith miller, which is equipped for finish-milling the angle on the bottom slide. The fixture employed in milling the 45-degree angle on the index-slide, Fig. 12, supports the work by two countersunk-head buttons, the angle of the head being 45 degrees, while the lateral position is established by means of a suitable locating pin. In the case of the bottom slide, however, it will be seen that a square surface is available to support the work, so that the plate *C* on the fixture is provided to accommodate this square surface. The roughing cut is performed with the work set in a vertical position in an ordinary milling machine vise, using a 45-degree single-angle cutter; but in finish-milling these dovetails, a slightly different method is employed. Instead of using a 45-degree single-angle cutter, the work is located at a 22½-degree angle from the vertical, as indicated in the illustration, and a 45-degree double-angle cutter is used.

It was found by attempting to mill these dovetailed surfaces with a single-angle cutter, that a less satisfactory surface for subsequent scraping was produced than with a double-angle cutter; it was further found that closer cuts could be taken so that the subsequent scraping operation on these surfaces could be considerably shortened. It is easy to conceive of a condition in which the flat side of a single-angle cutter would become worn sufficiently to produce a concave surface, which would be difficult to scrape flat. By using the double-angle cutter with the work tipped as required, the wear is equally distributed on both cutting edges. The wear is considerable at the point, but this does not affect the flatness of the surfaces. For each cut, the production time is seven minutes.

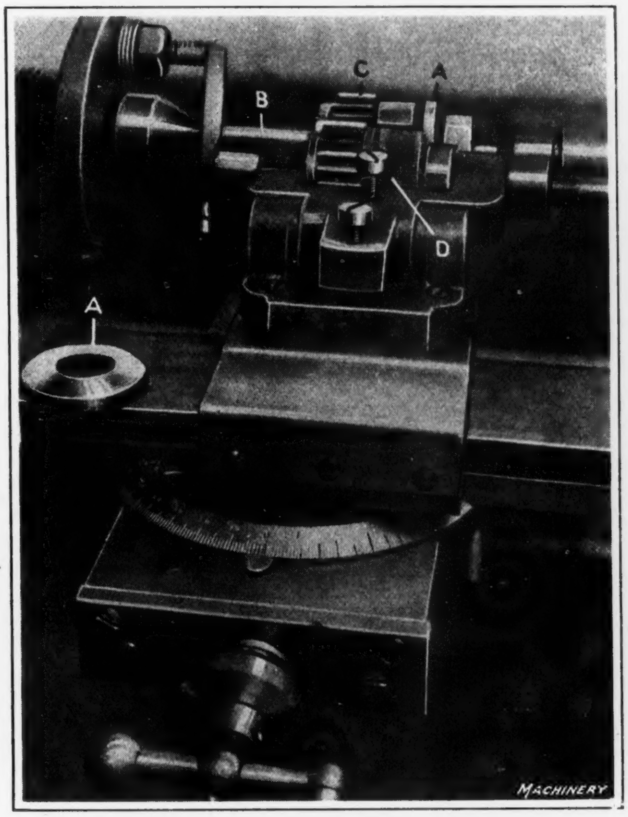


Fig. 15. Bench Lathe equipped with Gear-driven Device for rolling the Graduations into Feed-screw Index-collars

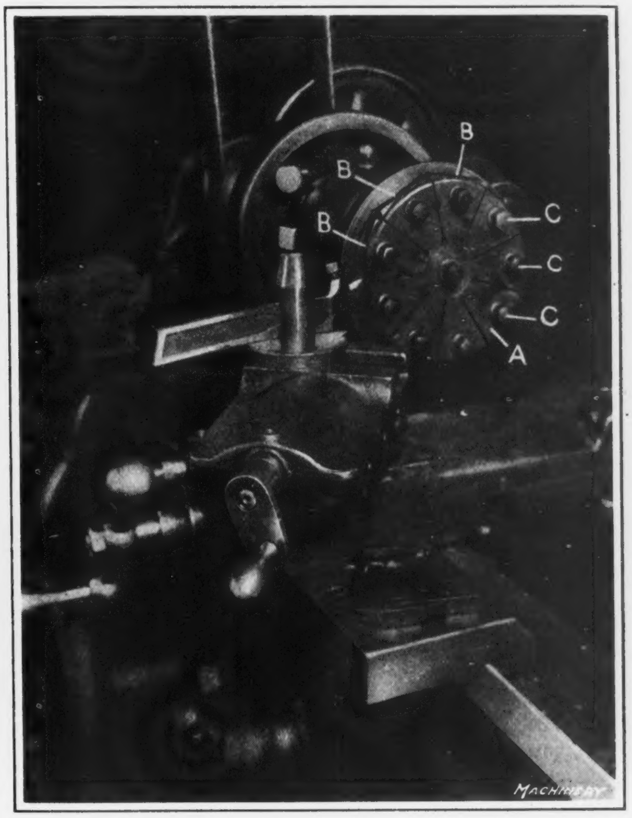


Fig. 16. Turning Toolpost Swivel Blocks from Bar Stock, using Fixture having a Capacity for Nine Pieces

Graduating the Sector Plate and Index-collar

The performance of the graduating operation on the disk *B*, Fig. 12, is accomplished by a hand fixture which is shown in Fig. 14. This device is inexpensive and accomplishes the work very quickly. On the under side of the table of the fixture there is a ratchet *A* having 360 teeth, the movement of which is controlled by two pawls, operated by handle *B*,

which may be seen on the side of the fixture. One of these pawls is of the take-up type and the other of the locking type. The marking tool is located in an angular position in head *C*, and is reciprocated by handle *D*. Its position may be adjusted radially by a cross-slide screw *E* of similar arrangement to that of the regular lathe cross-slide.

By operating the ratchet handle the graduated disk is revolved one degree with each movement and locked in this position by a pawl while the marking tool is brought forward by handle *D*, producing a graduation line of suitable length on the work *F* which is fastened to the turret of the fixture. Every fifth graduation must be longer than the others, and this is indicated when the index line on plate *H* coincides with the proper graduation on the ratchet. These different lengths of stroke for handle *D* are stopped off by inserting the stop or key *K* in the tool-head, when desired. The fixture is substantially constructed on legs so that it need not be anchored to the bench when in use. This is a rapid and satisfactory means of accomplishing this work without the use of an intricate automatic machine. After graduating, the burrs are cleaned off with a fine file, and the work is finished. The production time is ten minutes per sector plate.

Painting and Inspecting

The proportion of unfinished surfaces to finished ones on a bench lathe is so great that in order to add to the appearance of the machine it is necessary that care be exercised in the painting operations. In this connection, the painting of a bench lathe differs from that of the larger machine tools in that it requires considerable care in producing a proper finish. The parts are first cleaned to remove grease and other undesirable substances, and are then treated to an application of machine primer, which acts as a base or connecting medium between the bare metal and the subsequently applied coats of paint. The castings are allowed to dry for six hours after each coat of machine filler is applied with a brush. This filler is in the form of a thick paste and must be reduced to the consistency of heavy cream so that it can barely be applied with a brush.

In applying the filler, an ox-hair brush is used, and on the evenness of its application and the skill employed depends the amount of rubbing down or sandpapering which will subsequently be required. Several light coats are preferable to a lesser number of heavy coats. The castings are next sandpapered with a number of grades of garnet paper before the oil-proof machine paint is finally applied. The paints

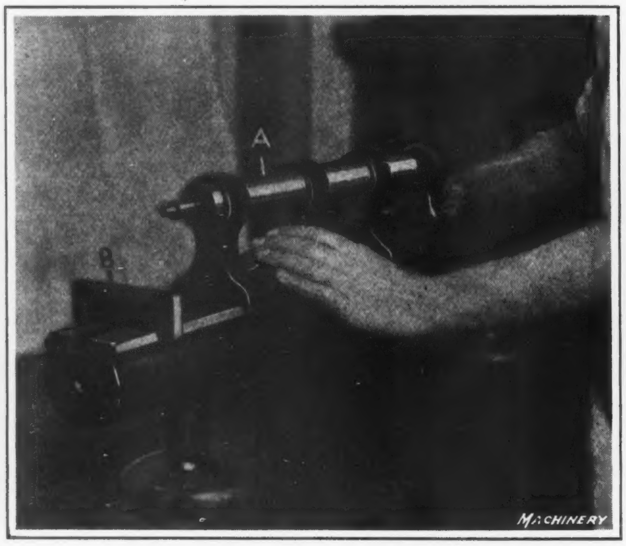


Fig. 17. Inspecting the Alignment of the Spindle Bores in the Headstock Casting

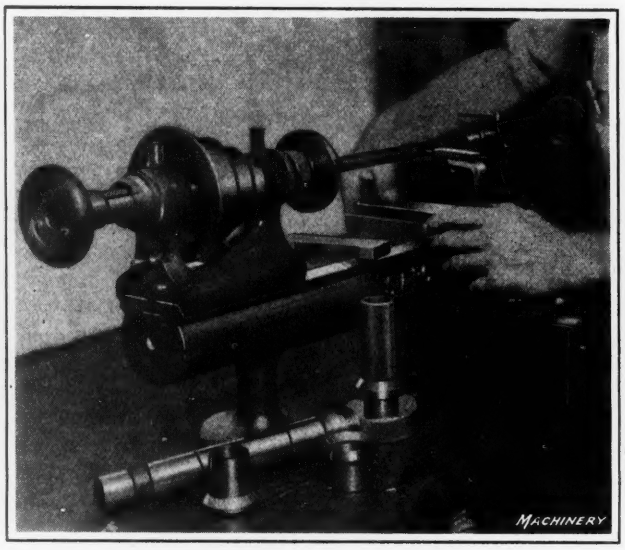


Fig. 18. Testing Assembled Lathe for Alignment, using Test Bar and Koch Indicator

used at the Potter works are manufactured by the Sherwin Williams Co.

The graduating of the feed-screw index-collar *A*, Fig. 15, is performed by the rolling process, but as the illustration shows, the device used is gear-driven and so is positive as regards the spacing of the graduations. This attachment is used in connection with a bench lathe. The arbor *B* is held between the lathe centers, and carries the gear *C*, which drives the tool *D*, by means of which the graduations are rolled on the collar when the slide is advanced to sink the marking teeth to the proper depth.

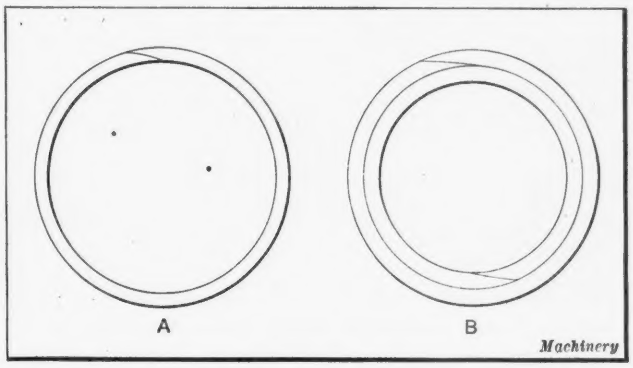
What is known as a toolpost swivel block or rocker is employed in the toolpost slot for tipping the tool to angular positions. This block is made from 3/16- by 3/8-inch cold-rolled flat stock, 1 7/8 inches long, and is turned to produce the rocker shape. The fixture especially designed for this operation is shown in Fig. 16, mounted on the faceplate of a lathe. This fixture consists essentially of two cast-iron disks *A*, which are normally held apart by coil springs. Each blank *B* is located near the periphery of the fixture between two small dowel-pins, and is clamped in this position by clamping nuts *C*. The outer disk contains nine radial slots so that it will yield sufficiently when the clamping nuts are tightened. This fixture has a capacity for nine pieces, and enables a high production rate to be obtained. A number of finished swivel blocks are shown lying on the carriage of the lathe. The production time is five minutes per set of nine parts.

The alignment of the spindle bearing holes in the headstock casting is inspected by mounting two of these castings in tandem on the finished bearing surface of a lathe bed, as illustrated in Fig. 17. An aligning bar *A* is then slid through the holes of the two castings, first with both castings in the same relative position and then reversed so that the two front bearing holes are adjacent as shown. The gage *B* shown resting on the surface of the bed is a profile gage used to inspect the top bearing surfaces on which the headstock and tailstock units fit.

In the final inspecting of the fully assembled lathe, an aligning bar is held between the lathe centers for the purpose of testing the working center lines, relative to the finished surfaces of the lathe base. The gage equipment for checking the parallelism and alignment consists of an accurately finished bottom slide casting, such as is regularly furnished with the Potter lathe, and a Koch indicator mounted on it as shown in Fig. 18. An angular faced block is adjustably attached to the under side of this bottom slide so that its finished surface may ride on the angular surface at the rear of the bed while the gaging device is slid back and forth on the lathe bed. This indicator is also used to test the concentricity of the angular surfaces of the lathe centers and their relation to the lathe bed.

Manufacture of Wrought Pipe for High Pressures

PIPE that is unusually strong in wall and weld is required for hydraulic purposes. The high pressures of hydraulic lines represent enormous bursting forces in many instances, and the potential energy of the water under such working pressures closely approaches that of the thrust of a steel rod working as a piston under similar pressures. To be dependable under such conditions, the pipe must be made with more than ordinary care; to be efficient, in view of the friction developed by the fluid under enormous pressures and high velocities, the pipe must be clean and smooth, and it must be possible to bend it without excessive distortion of the internal diameter, so as to insure uniform maintenance of velocities and the calculated working force of the fluid. These conditions require that the pipe be welded and rolled according to the best mill practice, and that the metal possess the unusual combination of high tensile strength and great ductility. This would be difficult to obtain if scrupulous care were not exercised, not only in the welding and rolling of the pipe, but also in the manufacture of the steel from which the pipe is made. Uniformity of material is essential to secure the proper strength, ductility, and rolling qualities. The practice of the National Tube Co., Pittsburg, Pa., in the production of wrought pipe will be found of interest in this connection.



(A) Position of Lap Weld in Standard Pipe; (B) Position of Welds in High-pressure Pipe

In the plants of this company, pipe for hydraulic and other high-pressure purposes is made from the ore into the finished product. The steel, being in the form of solid ingots, is rolled down to plates of the required dimensions without the laminations which characterize plates rolled from built-up bars of heterogeneous material. The cross-section of the pipe wall at any given point will, because of this feature, be found to be uniform and homogeneous, and the strength factor correspondingly uniform throughout the length of the pipe. Defects, such as blisters and blow-holes, are precluded in the skelp or plates from which the pipe is made by a mechanical process of working the metal in bloom or billet form. This process, which is employed in the production of pipe sizes up to and including 4 inches, is called "Spellerizing," and is a kneading process, which consists of subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom while still hot to the action of smooth-faced rolls, and repeating the operation. By this means the surface of the metal is worked so as to produce a uniformly dense texture and facilitate the escape of any confined gases which would cause defects of the nature mentioned.

Pipe Manufactured by Butt-welding

In the manufacture of pipe for high-pressure purposes by the butt-welding process, after the plates are rolled to suitable dimensions they are charged into a long gas-fired furnace, where they are heated to the proper temperature for welding. Prior to inserting in the furnace, a strong round bar is welded on one end of each plate as a tag or "bait" to be grasped by the tongs which draw the plate through a die, where it is bent into pipe and welded (see Fig. 2).

The hot plate is welded into pipe at a point close to the end of the furnace, by drawing through a die shaped like a bell with a hole in one end. The tag end is held by tongs which engage a draw-chain operating for the full length of a steel draw-bench. The chain exerts a tremendous pulling force on the tongs and pipe, and were it not for the fact that the tag end distributes these drawing strains evenly to the end of the pipe, the hot metal would tear and the welding could not be accomplished. The pipe is reheated and drawn several times through dies of this type having gradually decreasing diameters, until the proper size is obtained. This is done to thoroughly weld the very thick abutting edges of the seam and to provide the necessary strength at this point. In the manufacture of butt-weld pipe not used for high-pressure service, a sound weld is obtained by drawing the plate through the die only once, or through two dies in immediate succession at one heating of the plate, but the tremendous pressures carried by hydraulic pipe justify additional drawing operations to make safety and dependability as nearly absolute as they can be made. When the relative wall thicknesses of standard and double extra strong pipe, such as is required for high pressures, is considered, the reason for the multiple drawing of this butt-weld pipe is obvious.

Pipe Manufactured by Lap-welding

The larger sizes of pipe for high-pressure purposes are made by a process whereby the edges of the plate are overlapped at the seam instead of being abutted. This is called the lap-weld process. The plates are suitably rolled, and the longitudinal edges are slightly beveled where they are to overlap, in order to avoid undue thickness at the welded seam. They are then heated and bent into rough tubular form, with the edges overlapping, either by means of rolls such as those used in bending boiler plate, or by means of a bending die especially designed for the purpose. Thus bent, the rough tubes, or skelp, as they are called, are charged into the rear of a furnace where they are heated to a welding temperature. After reaching this temperature they are pushed out of an opening in the front of the furnace until caught by the revolving rolls of the welding apparatus situated a few feet from the opening. These rolls are so grooved that they form a circular opening between them of approximately the same size as the outside diameter of the pipe, and in this opening is a bullet-shaped mandrel, held on the end of a strong steel rod, as shown in Fig. 3. As the pipe skelp comes from the furnace it is caught by the rolls which force it forward over the mandrel, and thus press the overlapping edges together into a sound weld. The annular space between the mandrel and the roll opening is just

enough smaller than the wall thickness of the pipe to insure a gripping action of the rolls sufficient to carry the pipe forward and at the same time exert the necessary welding or forging pressure. Fig. 4 shows the pipe coming through the lap-welding rolls.

To make one length of the strong pipe used for certain purposes, two lengths of pipe are welded in this manner, and then telescoped; one length is slightly larger in diameter than the other to permit the easy insertion of one length within the other. This is so accomplished that the welds of the telescoped pipes are at diametrically opposite points, as shown at *B* in Fig. 1, and in this position they are reheated to a welding temperature and are both passed at once through the welding rolls, thus forging them into a single

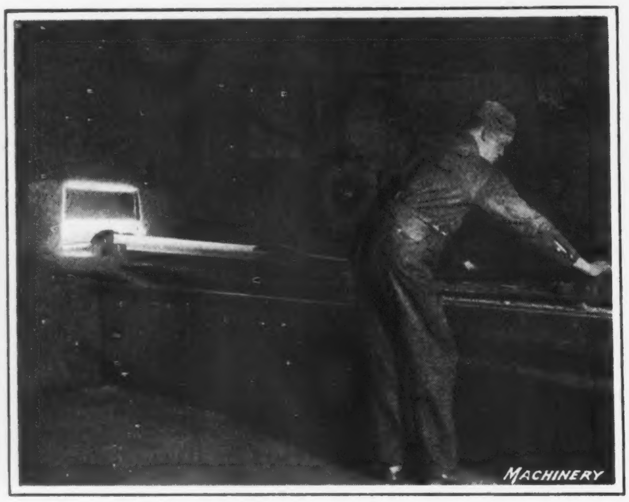


Fig. 2. Drawing and welding Skelp into Butt-welded Pipe

length of heavy-walled pipe. Maximum strength is thus obtained in the wall, while the welds are subjected to minimum pressure in service, due to their relative positions. The pipe is thus stronger than would be the case if made of one piece of thicker material joined with a single weld, as is the practice in manufacturing wrought-steel pipe in standard thicknesses. In the illustration, this is brought out by a comparison of standard and double extra strong lap-welded 6-inch nominal size pipe. The outside diameter of both pipes is the same, 6.265 inches, but the wall thickness of the pipe shown at *B* is 0.226 inch, whereas the heavy high-pressure pipe has a wall thickness of 0.864 inch.

Sizing, Straightening, Cropping, and Testing

After the pipe has been butt- or lap-welded, as the case may be, it is passed through rolls which give it the required outside diameter, and through cross-rolls to straighten it and give it its true circular shape, as shown in Fig. 5. The pipe is slowly cooled on a continuously traveling table, after

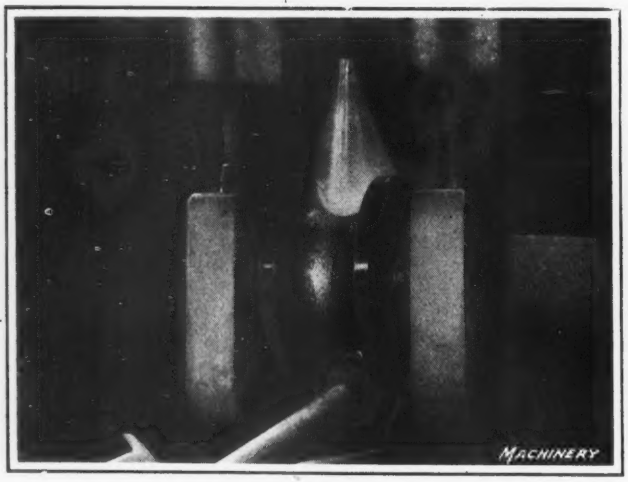


Fig. 3. Lap-welding Rolls, showing Mandrel in Position

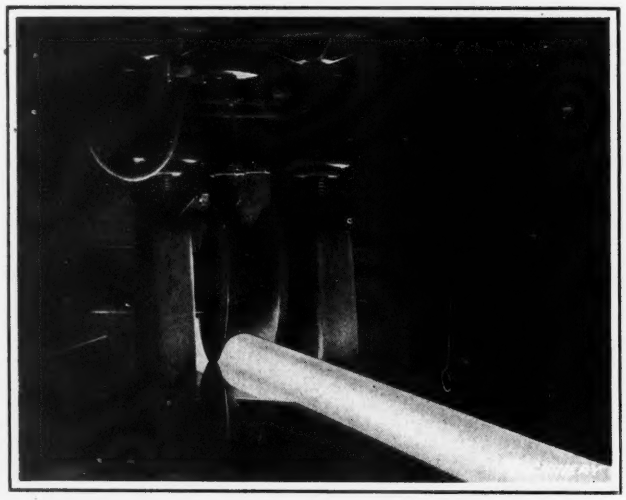


Fig. 4. Pipe coming through Lap-welding Rolls over Mandrel

which the tags and the ends which have become damaged in manufacturing are trimmed off, and the pipe is subjected to a hydraulic test to prove the soundness of wall and weld. Butt-welded pipe for high pressures (generally called double extra strong pipe) is tested by the manufacturers with a hydrostatic pressure of from 700 to 2200 pounds per square inch; double extra strong lap-welded pipe is similarly tested, using pressures of from 2000 to 3000 pounds per square inch —the pressures varying in both instances according to the pipe size. Hydraulic pipe which is made in nominal sizes of 9, 10, 11, and 12 inches, is tested with hydrostatic pres-

Fig. 5. Cross-rolls which straighten Lap-welded Pipe and give it a True Circular Shape

sures of from 1200 to 1800 pounds per square inch, depending upon the size and upon the wall thickness. Each of the above sizes is made in four different thicknesses or weights.

* * *

The number of factories destroyed or damaged in France during the war numbered 4241. Of these 3239 were working, fully or partially, on October 1, 1920. The number of workmen employed in 1920, as compared with those employed in 1914, was about 45 per cent. The greatest revival of industrial activity has taken place in the Lille region, the largest manufacturing center in France, where more than 75 per cent of the factories affected by the war have resumed production in whole or in part. In the metal-working field 844 factories were damaged or destroyed, of which 736 have resumed operation. Of 50 blast furnaces damaged or destroyed, 37 have resumed work. Fifty per cent of the normal force of employes formerly engaged in the metal-working industries is now at work. One-half the number of foundries and 45 per cent of the nut and bolt factories have resumed operation.

Taper-turning Tool for Spinning Machine Spindles

By W. BURR BENNETT, President, Wayne Engineering Co., Honesdale, Pa.

THE urgent demand for spindle blades for silk spinning machinery during the last two years made it imperative that a new method of producing these parts be evolved, which would give a higher production rate than had previously been obtained. To accomplish this, an investigation of the various methods and available machines for producing spindles was made by the writer. The making of spinning spindles has long been considered a forging and grinding proposition, and a product of high quality has always been obtainable by this procedure. Therefore, the makers of grinding machines were first consulted with the hope that some special type of grinding machine might be obtained which would give the required production rate. It was found, however, that grinding machines of the standard type were the best that could be obtained for this purpose, and that these machines were capable of fine work, but it was felt that the highest production rates could only be realized by the use of a special-purpose machine.

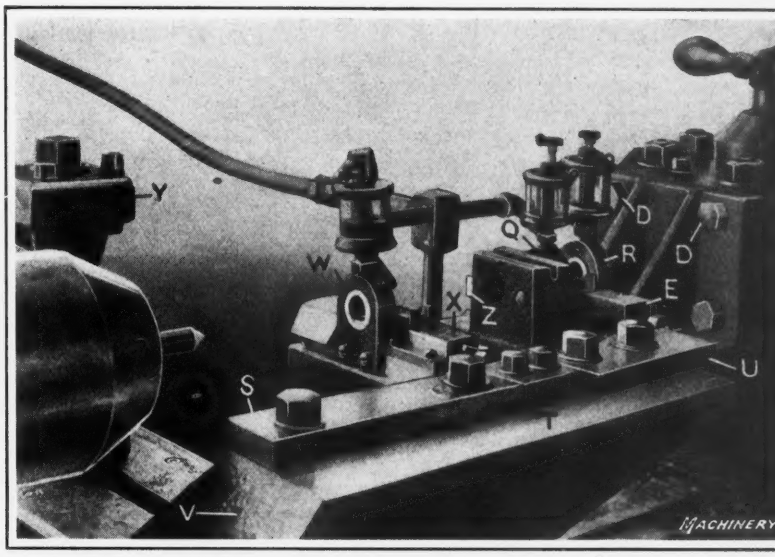


Fig. 1. Turret Lathe equipped for turning Tapered Spindles

Attention, therefore, was next directed to taper-turning machines and tools that might be employed in the production of spinning spindles from bar stock. Again there seemed to be no standard machine particularly adapted for the job. Some research work was then undertaken, which resulted in the development of the tool here described. This tool was designed jointly by W. M. Cummiskey, chief engineer of the Wayne Engineering Co., and the writer. Before proceeding further it should be explained that no criticism of the quality of forged and ground spindles is intended, the purpose of employing a different method being simply to increase production and at the same time to turn out spindles from bar stock which would be as good as the forged and ground product. It should also be stated that it is not the purpose of this article to describe the complete process of production, but merely to describe the tool and methods used in turning the spindles to size.

Details of Spinning Spindle Blade

The dimensions of the spinning spindle blade are shown in Fig. 3. The material is 1.20 per cent carbon tool steel containing certain other alloys which provide stiffness and wearing qualities. The stock is received from the mills in 12-foot lengths, 0.480 inch in diameter, and is fully annealed to provide free cutting qualities. This stock is held within close limits and is carefully straightened before using.

Machine and Feeds Used

The taper-turning tool equipment is shown in Figs. 1 and 2, mounted on a No. 4 Foster turret lathe. The complete machining of the spindles is accomplished on this machine. A feed of 0.004 inch per spindle revolution was first used, but it was later found that under favorable conditions the feed could be increased to 0.007 inch. A cutting speed of about 90 surface feet per minute is now generally employed, although it is necessary to change the speed occasionally to compensate for the variations in the physical properties of the stock. The maximum speed attained under favorable conditions was 100 feet per minute with a feed of 0.004 inch per spindle revolution.

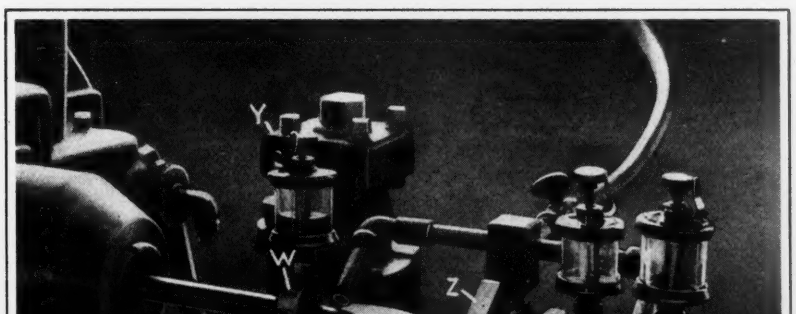


Fig. 2. Taper-turning Tools in Operation on Spinning Machine Spindle

The constructional details of the cam-controlled tool-slides *E* and *X*, the bushing-holders *W*, *Q*, and *R*, by means of which the work is supported, and the tool-slide blocks *I* are more clearly shown in Fig. 4. The controlling cams are mounted on casting *V*, Fig. 6, which is keyed to the cross-slide of the machine. The cams are shown by heavy dot-and-dash lines at *S*, *T*, and *U*, and their relative positions may be seen in Figs. 1 and 2. These cams are so located that the spindle is

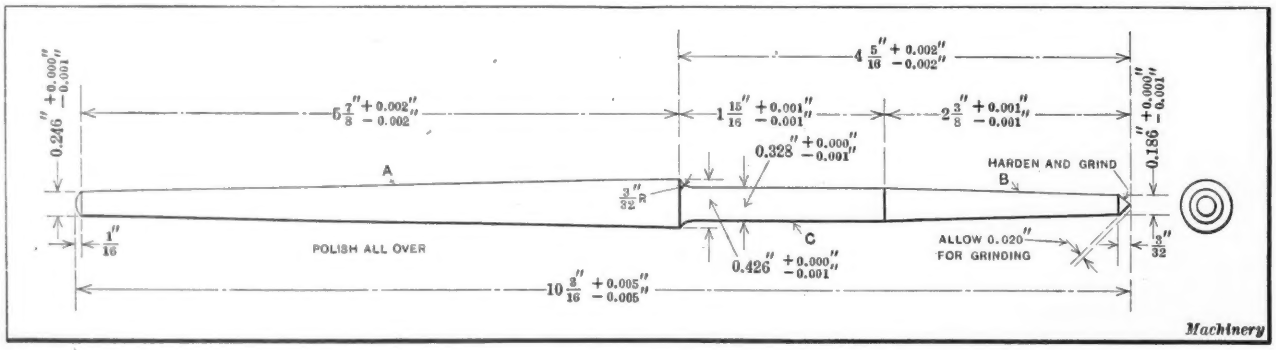


Fig. 3. Details of Spinning Spindle Blade

turned with the short taper *B*, Fig. 3, extending toward the turret. From Fig. 1, it will be seen that a conical point is formed on the end of the stock before starting the taper cuts. This is accomplished by a parting or cutting-off tool mounted at the back of the cross-slide in tool-block *Y*.* This cutting-off tool is of special design, and in addition to forming the conical end, rounds the opposite end of the finished spindle. It will be seen that oil-cups are provided in holders *W*, *Q*, and *R* for lubricating the bushings that support the work. At first oil was used in these cups, but it was later found desirable to use a thin solution of machine oil and white lead. Soluble oil is used as a coolant, and the feed-pipes through which it is conducted to the tools are connected to the pumping system of the machine by means of a flexible hose.

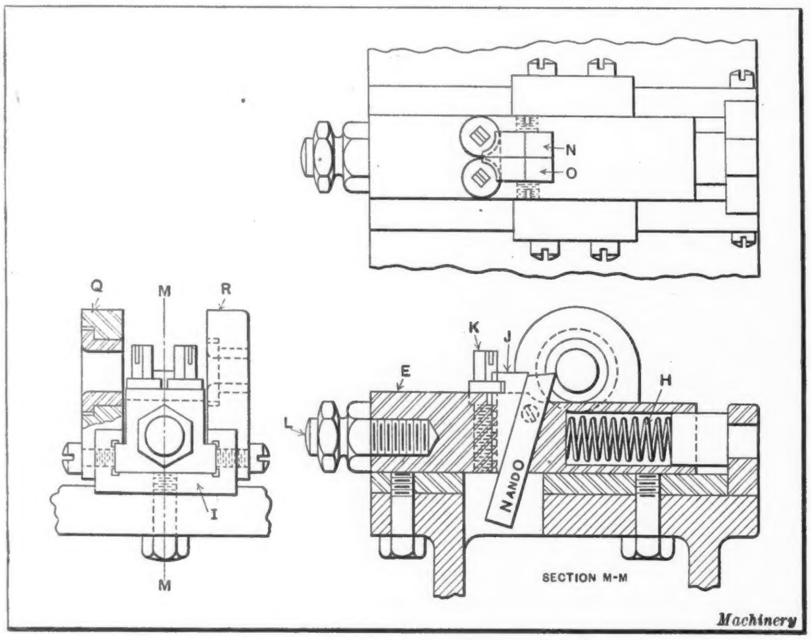


Fig. 4. Diagram showing Design of Cam-controlled Tool-slides

Construction of the Turning Tool

The main casting on which the turning tool slides are mounted is shown in Fig. 5. This casting, as will be seen by referring to Fig. 1, is mounted on the turret, being secured in place by four cap-screws *D*. It is necessary that this part be made of well-seasoned cast iron, and of sections and proportions which will give ample strength to resist the strain imposed on it. At *Z*, Fig. 5 (see also Figs. 1 and 2), there is shown a swinging stop which is used in conjunction with the turret stop on the machine. When the machine is in operation, the turret is moved up to its stop, and the stock fed out until it comes in contact with stop *Z*, whereupon this stop is swung back, and the cut started after first feeding the cross-slide of the machine in to the proper depth, as indicated by the graduated dial of the cross-feed screw. As stated previously, there are two tool-slides mounted on the main casting, and these are located in grooves *F* and *G*.

Referring to Fig. 4, it will be seen that tool-slide *E* operates in the slide-block *I*, and that this block is secured to the main casting by cap-screws. It will also be noted that the bushing-holders *Q* and *R* are secured to block *I* by machine screws. The bushings by which the work is guided are carefully hardened, ground, and lapped, the one carried in holder *R* being a good fit over the 0.328-inch finished diameter of the spindle (see Fig. 3). Tool-slide *E* is also hardened and ground, and is provided with the two tool bits *N* and *O*, which work simultaneously, one taking a roughing cut and the other a finishing cut. Two wedges *J*, operated by screws *K*, hold the tool bits in place and provide a means of adjustment. The tool-slide is held back by the compression spring *H*. Adjusting screw *L*, the head of which is held successively in sliding contact with the cams *U* and *T*, Fig. 6, adjusts the tool-slide transversely. A similar construction is employed for tool-slide *X* and cam *S*, Figs. 1 and 2.

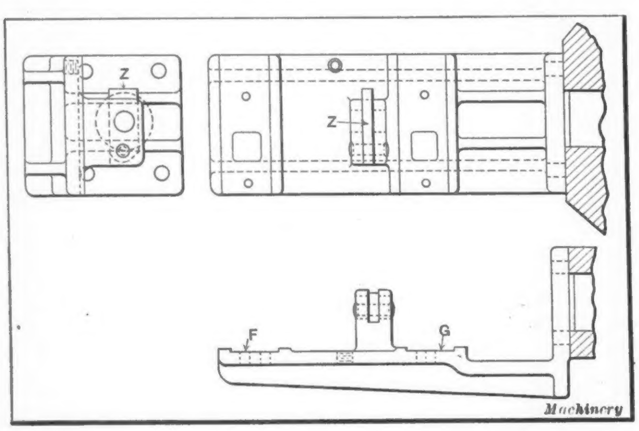


Fig. 5. Casting attached to Turret for supporting Turning Tools

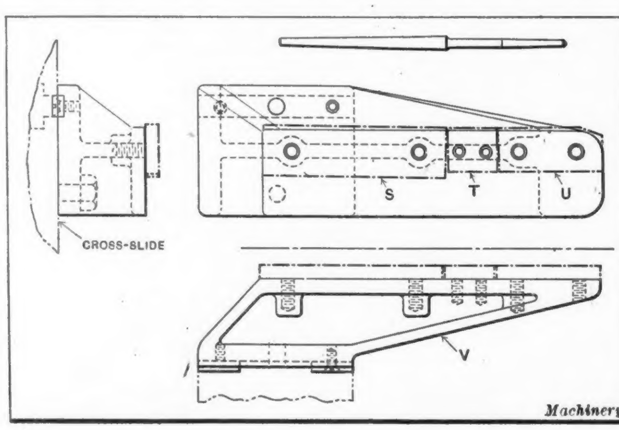


Fig. 6. Casting attached to Cross-slide for supporting Tool-slide Cams

Operation of the Tool

The following brief explanation will give a clear idea of how the tool operates. Assume that a finished piece has just been cut off, and the conical point formed on the stock by the tool held in block *Y*, Figs. 1 and 2. The operations required to finish another piece would be as follows: First bring the carriage back to the extreme right-hand position; then throw stop *Z* forward into the position which it occupies in Fig. 2; next run out the stock until it comes into contact with stop *Z*; feed the cross-slide in to the correct depth and engage the forward feed. The adjusting screw in the end of tool-slide *X* is held in contact with cam *S*, and will cause the tool to turn section *A*, Fig. 3, to the required taper. When the tool has advanced along section *A*, a distance equal to the length of section *A* plus the lengths of sections *C* and *B*, the tools held in block *E*, Figs. 1 and 2, guided by cam *U*, will begin to turn the tapered section *B*, Fig. 3. When slide *E* reaches cam *T* no transverse movement will be imparted to the tool, so that as the slide continues to the left, the straight cylindrical section *C* will be turned. The bushing in holder *R*, being carried directly back of the finishing tool, supports the work when nearing the end of the cut. The feed is automatically stopped when the cuts are completed. The operator then feeds the cutting-off tool forward, thus severing the finished piece. The machine is now ready to repeat the operation.

In summing up, attention is called to the fact that two roughing and two finishing tools are in operation at the same time—a feature which greatly shortens the production time. The results obtained by the use of this tool fully justified the cost of developing it, as it has not only proved capable of maintaining the limits of accuracy indicated in Fig. 3, but has given a higher rate of production than could be obtained by the grinding process.

* * *

INVESTIGATION ON SLUSHING OILS

The United States Bureau of Standards has made an investigation on the properties of slushing oils. The complete report of the investigation, prepared by P. H. Walker and Lawrence L. Steele, is given in Technologic Paper No. 176 of the Bureau of Standards. Briefly stated, the report arrives at the following conclusions:

Slushing oils are materials used for protecting bright metal where it is not feasible to use paint, varnish, or other fixed coatings. An ideal slushing oil is one that can be easily applied to all kinds of metal surfaces by a variety of methods. It should coat the surfaces with a sufficiently thick and impervious film to exclude moisture and air (to prevent rusting), should remain in position for an indefinite length of time, and yet be completely removable from the surface without undue labor. The material should itself have no corrosive action on any kind of metal. The report contains a discussion of properties and methods of testing, most of which were developed in the course of this investigation, and summarized results of tests of a number of samples. From a study of numerous laboratory and exposure tests, proposed specifications are given. The specifications suggested are based upon properties of the finished product rather than chemical composition. Formulas are given of some satisfactory mixtures, which are cited as examples of easily made preparations for protecting metal.

DIES FOR ELECTRIC LIGHT SHADES

An order recently came to the Phoenix Tool Co., 2 Remer St., Bridgeport, Conn., to design and make dies for use in the manufacture of electric light shades of the form shown at *B* in Fig. 1. These pieces are drawn from sheet brass, and after studying the problems connected with their production under the power press, it was decided to divide the work up into two operations. The first draw produces a shell of the form shown at *A* in Fig. 1, and then a second operation is necessary for trimming off the closed end of the shell to make a finished electric light shade of the form illustrated at *B*.

Design of the Drawing Dies

Sheet brass from which these pieces are made is purchased in the form of ribbon stock, so that it may be conveniently fed to the dies from a reel. It will be seen that guides *C* are furnished on the drawing dies shown in Fig. 2, which provide for directing the ribbon stock to the lower die. The stock advances until its progress is checked by a stop *D*, and then the upper die member descends. One edge *E* of this block is arranged to work in conjunction with the edge of a plate *F* carried by the lower die member, to provide for shearing off a blank of the proper length from the ribbon stock. Further downward movement of the upper die results in gripping the brass blank between the faces of the upper die-block and plate *G* carried by the lower die member. This plate is pushed downward by the upper die, against the tension of a rubber pressure pad located beneath eight plungers adjacent to the guides *H* that are secured to plate *G* by set-screws. The brass blank is held between the upper die-block and plate *G* by this spring tension in a way that prevents it from wrinkling while the drawing operation is in progress.

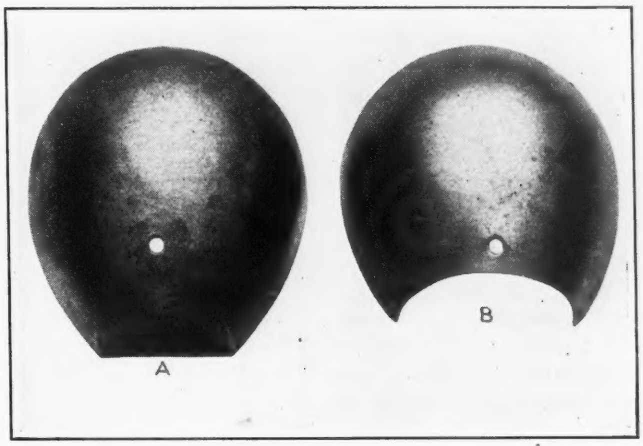


Fig. 1. Drawn Brass Shell A and Finished Electric Light Shade B

As plate *G* is pushed downward, a form *I*, of the same shape and size as the inside of the shell to be drawn, rises through the opening in plate *G* and enters the clearance space provided in the upper die member for its reception. The brass blank, which is held between the faces of the upper die-block and plate *G*, is thus drawn over form *I* and exactly duplicates its shape. The final result is a shell of the form shown at *A* in Fig. 1; the small hole in this shell is pierced by a punch *J* carried by form *I*. To any experienced mechanic it will be apparent that there will be a flash around the edge of the shell, left by the excess metal in the blank. This flash is trimmed off by the same operation which draws the shell. At the bottom of form *I*, it will be seen that there is a sharp edged block *K* which is of the same thickness as plate *G*. This block rises through the opening in plate *G* and at the bottom of the stroke of the press, it just enters the opening in upper die-block *E*, thus providing for shearing the excess metal from the drawn shell. This completes the first operation, the second operation consisting of trimming off the closed end.

Trimming Die

It has already been stated that a separate operation is employed for trimming off the closed end of the shell to bring the finished piece into the condition shown at *B* in Fig. 1. This operation is performed with a die that is manipulated by hand, this die being set up on a treadle-operated punch press. The trimming die shown in Fig. 3 forms the lower corners of the shell, and then a shear blade carried by the

treadle-operated ram comes down and cuts off the end of the shell. As shown in Fig. 3, there is a form over which the shell can be dropped and located by means of a pin *L* that enters the pierced hole in the work. The trimming operation on the corners is accomplished in two stages by first throwing hand-lever *M* forward and then pulling it backward. Secured to the front of the form over which the shell is dropped, there is a tool-steel block *N* which is formed to accurately fit the contour of the inside of the shell and to have its right-hand end extend to the line on which the shell is to be trimmed; the lower right-hand edge of this block is formed to a radius corresponding to the shape to which the corners of the work must be trimmed.

Secured to the left-hand end of lever *M* there is a sliding trimming shear *O* which contacts with block *N* in a manner best shown in the lower cross-sectional view. When lever *M* is oscillated, it will be apparent that the shell dropped over block *N* occupies the space between this block and the shear *O*, so that when this shear is moved forward and backward by two successive movements of hand-lever *M*, it provides for trimming off the end of the shell to bring it to the desired condition. The design of the trimming die will be apparent from the illustration.

It will be seen that hand-lever *M* is pivoted at *P*, and that the short end of this lever extends into an opening in shear blade *O* to provide for its oscillation. An ample leverage ratio is provided between the two arms of lever *M*, so that the exertion of a moderate pressure on the lever applies an ample force on the trimming die. It will be evident that the trimming shear *O* has an extension *Q* at its right-hand side, which fits under guiding plates *R* that are secured to the die by means of dowel-pins and screws, as clearly shown in the plan view. At the center of the shear a pocket is cut in the projection *Q* that extends under the guides *R*, to form a space to receive the left-hand end of hand-lever *M*, as previously mentioned.

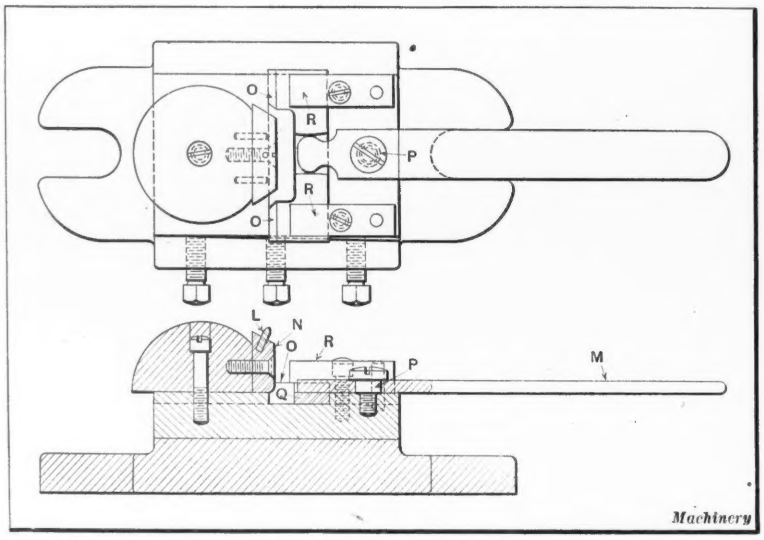


Fig. 3. Hand-operated Die for trimming Shells A to Form shown at B, Fig. 1

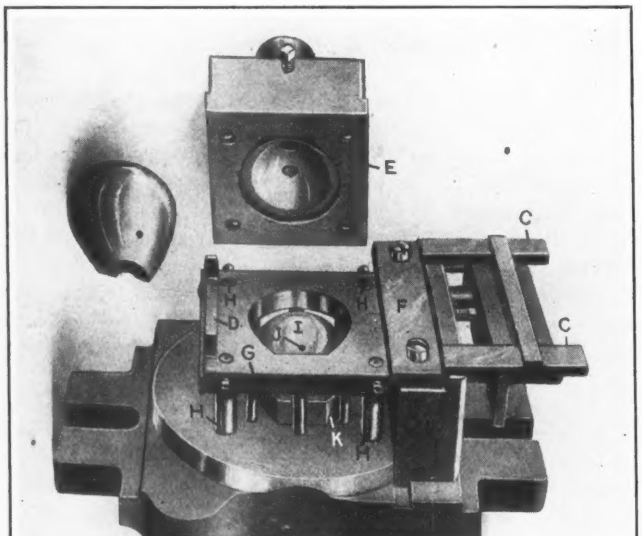


Fig. 2. Upper and Lower Dies used for drawing Shells of Form shown at B, Fig. 1

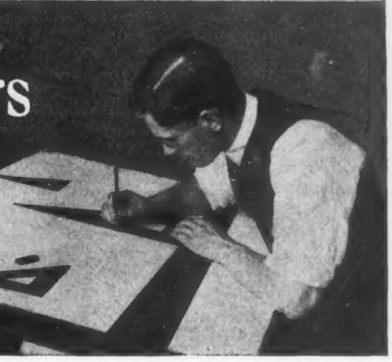
WASTE OF LABOR CAPACITY

In an address made by Herbert Hoover, president of the American Engineering Council, the governing body of the Federated American Engineering Societies, at a recent meeting of the council, the waste in production, measured by unemployment, lost time due to labor friction, loss in labor turnover, and failure to secure maximum production of the individual in the industries, was pointed out. In addition to this waste Mr. Hoover dwelt upon the waste due to poor coordination of great industries and the failure of the transportation system and the mining industry to meet the nation's requirements, thereby interrupting the steady operation of industry. Mr. Hoover pointed out how by intense production in 1918, with 20 per cent of our man power in the army, we produced 20 per cent more commodities than we are producing today. Now we are probably not producing more than from 60 to 70 per cent of our capacity, and our national industrial machine is incapable of employing more than two out of every three men ready to work.

"While we often assume that great advances in living standards are brought about by new and basic inventions," said Mr. Hoover, "even a greater field of raising the standards lies in the steady elimination of the waste referred to. The primary duty of organized society is to increase the standards of living of the people. The Federated American Engineering Societies, therefore, propose to make a primary examination of the waste in certain industries and to make constructive suggestions to remedy the faults. There is no such thing as national over-production if the industries produce the right commodities. The commodities or service produced by the whole nation is capable of absorption by the whole nation. It is true enough that any particular commodity or service can be over-produced, if it reaches a point in demand where all the members in a community have been supplied. The absorption of increased activity lies in the conversion of the luxuries of today into the necessities of tomorrow, and to spread these among the whole nation by stimulation of habit and education. To put the matter in another way, there is no limit to consumption except the total capacity to produce, provided the surplus of productive power is constantly shifted to new articles, from those that have reached the saturation point of demand."

The problem is one of infinite complexity, and Mr. Hoover did not suggest that the forces of production can be shifted by national direction, but he believes that it is practicable for engineers and business men to take hold of the matter and to eliminate some of the waste of human labor in production and to create, through the normal processes of business, new channels of employment.

Common Causes of Errors in Machine Design



Manufacturing Cost—Transportation of Machines—Compactness and Appearance
Fourth of a Series of Articles

By R. H. McMINN

THIS is the fourth of a series of articles, which began in the January number of MACHINERY, dealing with common causes of error in design and discussing fundamental points that must be considered in designing machines. The present installment takes up the influence on design of the manufacturing cost, restrictions imposed by transportation facilities, and considerations of compactness and appearance.

Manufacturing Cost

The designer must always keep in mind the cost of manufacturing the machine he is working on. If the machine is a special one and has been sold before being made, there has evidently been an estimate made of its cost in order to determine its sale price. The estimate should be examined carefully, and limitations on new patterns, kind of material, and amount of machine work must be followed closely, unless there has been a serious error in the estimate and the use of old patterns, kind of material specified, or the extent of machining conflicts with the suitable design or operation of the machine or with the purchaser's specifications. The design must not cover a machine that is more refined than necessary, or that performs operations not required by the specifications.

Whether the machine is being made before or after its sale, the consideration of cost is a very important one. Old patterns should be used if practicable. If new ones are required, they should be as simple to make and mold as possible. Finish should be allowed only where required. The allowance for fits should provide for as easy assembly as possible consistent with operating requirements. The designer should seek the least number of changes in settings for finishing each part. He should try to prevent difficulties in laying out work in the shop; for instance, he should not insist unless absolutely necessary, that a length of thirty-seven inches be divided into seventeen equal spaces. The different sizes of cored, drilled, tapped, or punched holes in any part should be as few as practicable.

Waste of Material and Labor

Waste of material should be watched. If the first design of a machine seems to demand a steel plate 60½ inches wide when the next width procurable above 60 inches is 72 inches, an examination may show that a slight modification will permit the use of a plate 60 inches wide. In quantity production, attention should be given to cutting the maximum number of odd shaped pieces from one sheet by seeking their best arrangement on the sheet and possibly modifying the design to reduce waste.

The shop's standard machines and tools should be used if possible, especially if only one or a few machines are to be built from a design. Shop standards should be adhered to as closely as possible, and stock parts utilized. Nothing unusual to machine or of uncertain result in operation should be introduced if avoidable.

When designing a machine which is to be made in large quantities, a saving in material or labor on any one part might amount to a large sum on a large number of machines built. The number of machines to be built may therefore largely affect the selection of permissible methods of manufacture. Quantity production demands that more time be given during design to the cost of each machine. However, if a man should be engaged on a design for building only one machine and should seek the very cheapest method of building everything, the time spent in doing this might be such a large factor in the expense that it would offset his efforts. Therefore the proper medium must be sought also in designing labor.

Transportation of Machines

All units of a machine must be loaded by the manufacturer, transported—usually by the railroad—unloaded by the purchaser, and moved to the exact point of erection. Restrictions in size or weight of any part or the extent to which a machine may be assembled for shipment depends on conditions surrounding all of these movements.

A manufacturer must have equipment of sufficient capacity to handle the heaviest single parts or assembled units of the kinds of machines he usually builds, and this should have some excess capacity. If these requirements be exceeded, he can probably devise or secure special means for transporting around his plant and loading extra heavy parts of any machine he wishes to build. Sometimes unusually long members must be taken diagonally through a door in a building in order to remove them. If the member is so long that one end interferes with a column, wall, or machine, a joint may have to be provided so it may be moved in two parts. To avoid such difficulties, shops that customarily handle long material, such as structural shapes, have doors in the end of the shop, if possible, where railroad tracks enter parallel to the longest dimension of the building. Large flywheels or gears are made in sections partly to meet transportation restrictions, as in the width and height of doors.

Transportation by Rail

Transportation by rail has limitations in the weight, width, height, and length that can be handled. Machinery shipments by rail are usually made in box cars or on flat cars. The average size of box car is about 8 feet 6 inches wide by 8 feet 6 inches high by 40 feet long inside, having a capacity of about 40 tons. The average flat car is about

the same length and capacity, and has a platform about 9 feet wide. There are many box and flat cars in service that considerably exceed these sizes, but their use may be prevented by the limitations of a particular route. The maximum allowable gross weight of a car and lading varies with different routes due to the difference in capacity of the bridges over which a car must pass; the length of car that can be handled is determined by the degree of any curve to be encountered; and the permissible width of lading and its height above the rail depend upon the clearances of the road or roads over which the car must go.

Heights may be restricted by tunnels and viaducts. The width of the lading cannot exceed the width of the car upon which it is loaded. The allowable width of the load on open cars at different heights above the rail is variable, because the side clearance varies with the height above the rail. If the load projects over an idler car, or rests on two adjacent cars, or is borne by two cars with an idler between, the allowable width of the load is reduced to prevent it from projecting beyond the edge of the car on curves.

Some mountain roads in this country have narrow gage, sharp curves, and small side clearance, which reduces the size of their cars and hence of any loads that can be handled. If material must be transferred to one of these narrow-gage roads, this must be taken into account. If it appears that a machine or structure will have large or heavy shipping units it is well to consult the Master Car Builders' loading rules, and to obtain the weight and length limitations and the line clearances of the route over which material must be shipped, before deciding upon the design.

When Machines are Exported

If a machine must be shipped by sea, the maximum weight of any shipping unit depends upon the ports at which the machine is loaded and unloaded. The best equipped ports can handle complete medium-weight locomotives, and these have been loaded and unloaded at such ports completely assembled, except for the stack and other parts, which might be easily broken during handling and transport. However, it is customary to dismantle and box most machinery for its own protection, for ease of handling, and economy of space and cost. At some ports these boxes must be transferred in the open sea from the ship to a barge known as a lighter, and the allowable size and weight of the boxes is often quite restricted. If the material shipped is destined for the interior of an undeveloped country, this may place still further restrictions on size and weight due to the methods by which it must be transported—possibly by mule or camel. Some machines evidently could not be designed to meet such limitations, while others could be designed to consist of sufficiently small units to transport if the exact conditions were determined in advance.

Transportation over Public Roads

If the manufacturer's or purchaser's plant is not on a railroad spur, the limitations of moving a machine by truck or other means must be considered. Here the kind of road or soil that may be encountered by the carrier may limit the weight of any single unit. City regulations may restrict the load on a pavement or bridge, which must be passed over. The designer must consider clearances of overhead wires or viaducts, if any part to be handled is of great height; the ability to pass other vehicles, if the material is wide; or to turn corners, if it is long.

It is possible that some machine cannot be designed without a part so large that it will not enter the purchaser's building without removing part of a wall. The question of transporting the parts of a machine from the point of manufacture to the point of erection should be given careful consideration during design, and if any unusual methods must be employed the consent of the parties affected should be obtained before proceeding with the manufacture.

Compactness and Appearance

Compactness in design must always be sought. Space is valuable and often limited, and the size of a machine frequently determines whether it can be used in the only space available. Careful attention to this element of design will usually suggest economies in the space required.

The outward appearance of a machine cannot be ignored in its design. Some early machines for shop use were ornamented by scroll work, but this practice has been discontinued. Some machines for store and office have their exterior surfaces rather elaborately embossed, but the present tendency for such machines is toward a smooth enameled exterior. Certain "lines" add much to the appearance of such machines as automobiles which are made partly, at least, to be seen as well as used. Appearance counts for more in a machine for machine shop use than in one for a foundry or a coal mine. Utility must never be sacrificed for the sake of appearance, but appearance can often be aided by compactness, correct proportions for strength, well rounded edges, and a judicious use of curves in outlines.

The next installment of this article, which will appear in the May number of MACHINERY, will consider the influence of working environment on the design of a machine and the reaction of the machine upon its environment.

* * *

THE METRIC SYSTEM IN THE EXPORT TRADE

It has always been maintained by those who believe that the English system should not be replaced by the metric system in the United States, that the English system of weights and measures does not hamper the export trade, and that the metric system is not required for the promotion of this trade. In a statement sent out by the American Institute of Weights and Measures, 115 Broadway, New York City, a quotation is made from the Philadelphia Chamber of Commerce "News Bulletin," as follows:

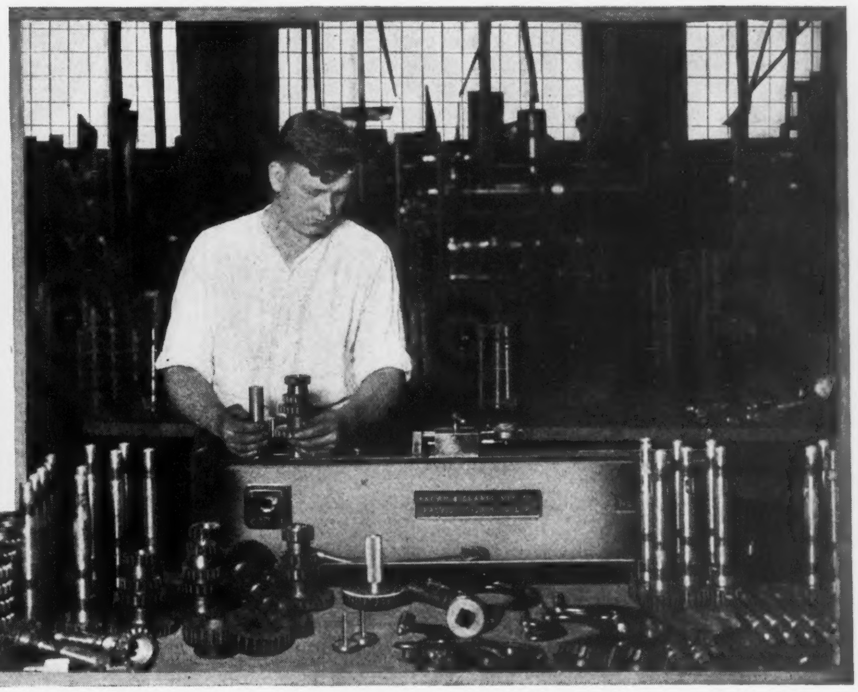
"In six years' time the exports of American machinery have trebled in value. In 1913 the total exports of machinery were valued at $127,980,000, while in 1919 they reached a total value of $378,425,000. That the total in the latter year was not greater was due to the urgent home demands for machinery of almost every description, which limited the amount available for export. Today, in addition to their branch offices in Europe, several American manufacturers maintain staffs in the Far East, Australia, and throughout South America. It is also a fact that American manufacturers, because of the efficiency of their manufacturing methods, are able to compete successfully with European manufacturers, even in countries where the tariff is in favor of the Europeans. This tremendous increase in the demand for American machinery may be traced to three causes: (1) The world-wide need of labor-saving machinery; (2) the adaptability of American machinery for almost every purpose; and (3) its low cost due to American methods of quantity production."

In view of this it is hardly reasonable to assume that the English system of weights and measures hampers the export trade of the United States. The tremendous growth of the export trade in American machinery, built to the English system, may be considered as sufficient proof that the metric system is not necessary to promote export trade.

* * *

Preliminary researches made to determine the value of alcohol as a fuel for automobile engines indicate that alcohol possesses most of the properties necessary for a good motor fuel. While its heat value is lower than that of gasoline, it may be used at higher pressures than the latter fuel. It was found advantageous to mix the alcohol with 20 per cent of gasoline, as such a mixture would start readily in cold weather and run the engine very smoothly.

Quantity Production in a Gear Shop



Practice of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y., in the Manufacture of Gears for Tractors, Trucks, and Automobiles—First of Two Articles

By FRED R. DANIELS

THE making of gears in quantities presents many problems differing from those that arise when only one or a small number of gears are made at a time. Hence a description of the methods used in a shop specializing in the production of gearing in large quantities is of particular interest to men in the mechanical field. The following article deals specifically with gears used for tractors, trucks, and automobiles as made by the Dittmer Gear & Mfg. Corporation, Lockport, N. Y. There are a number of preliminary steps in the manufacture of these gears that are of great importance in meeting the exacting requirements of the automobile trade, and many precautions must be taken in order to insure a high-class product.

Testing and Preparing the Stock for the Machining Operations

In the first place, drillings are taken of all bar stock and forgings received in the plant, for the purpose of analysis, and until this analysis has shown that the steel meets the specified requirements for gear purposes, the material is not sent to the shop. All forgings are annealed in Rockwell carburizing furnaces, and pickled for about one hour in a 30 per cent solution of sulphuric acid, for the purpose of cleaning the exterior surfaces. The forgings are then washed in boiling water and are subjected to an acid neutralizing bath of boiling lime, which neutralizes any sulphuric acid yet remaining on the forgings. After thus preparing the steel for subsequent machining operations, both by improving its structure through the annealing process and by the removal of all iron oxide scale, the forgings are delivered to the machine shop.

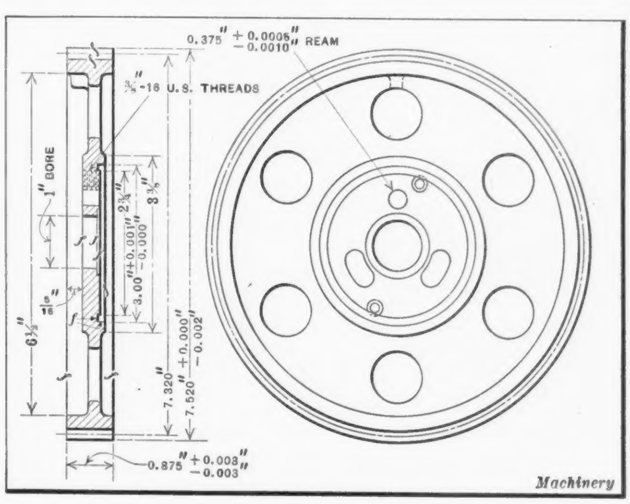


Fig. 1. Detail of Automobile Camshaft Gear

In the case of alloy steel bar stock, which is used extensively in the manufacture of gears of plain design, this preliminary treatment is unnecessary, so that the first operation is to cut the bars into disks of suitable thickness. This is done on a power cut-off saw. For cast-iron blanks, from which plain gears such as automobile camshaft gears are made, no preliminary treatment is required other than to allow the blanks to lie out in the open and accumulate a heavy coating of rust, as a means of improving the quality of the iron.

In machining plain gear blanks such as shown in place on the machine in Fig. 2, the first operation consists of facing, and of drilling and reaming the center hole, and this illustration shows the operation in process. The machine is a Baker Bros. drilling machine, and is shown performing a spot-facing operation. The work is chucked in a Barker wrenchless chuck, and is machined with a Genesee spot-facing tool. The finished face of the work is subsequently used to locate the work for the broaching operation which follows, so that assurance may be had that the hole will be perfectly perpendicular to the face of the work. The illustration shows the method in which gear blanks having a central hole are handled in transporting them through the shop. It will be seen that the gears are placed on spools, after being machined, which have a circular base so that they can be rolled from machine to machine for the different operations.

Automobile Camshaft Gears

Cast-iron gear blanks from which camshaft gears such as shown in Fig. 1 are machined, as well as all other castings of this type, require very little handling and do not demand any elaborate

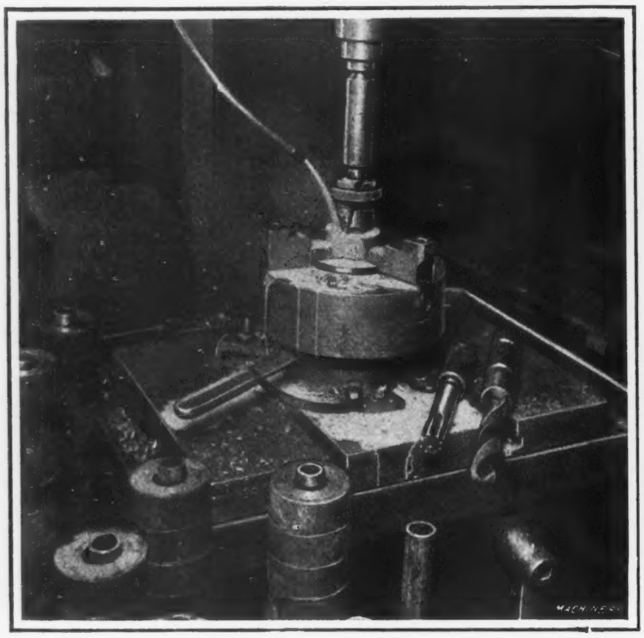


Fig. 2. Spot-facing Gear Blanks prior to broaching

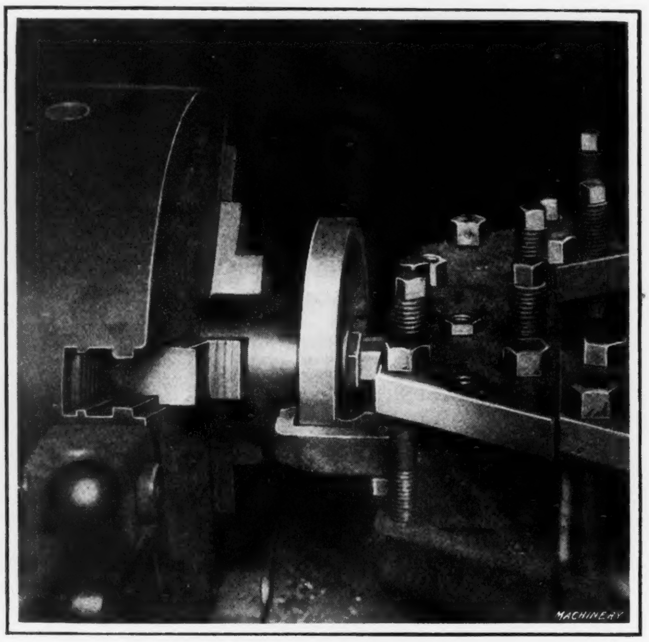


Fig. 3. Turret Lathe equipped for facing Camshaft Gear

equipment in their production. They are first machined on a Jones & Lamson turret latne, as shown in Fig. 3, the operations consisting of drilling the central hole, facing both sides, and finish-turning the outside diameter, using the regular tooling equipment. The illustration shows the tooling for the straddle-facing operation, and the method of mounting the work on a special arbor held in a three-jaw chuck. The standard time for performing the roughing out operations is sixteen minutes, floor to floor.

This particular gear has sixty 10-pitch right-hand spiral teeth cut on its periphery, the helix angle being 34 degrees 56 minutes 14 seconds, and the lead of helix 32.918 inches. The practice in machining spur gear teeth in this plant is to first rough them out by the hobbing process and then finish them on Fellows gear shapers, except, of course, where the design of the gear will not permit sufficient space to use a hob. After the camshaft blanks have been roughed out on the Jones & Lamson machine, the various holes are drilled and tapped, and then the spiral teeth are finish-cut by the hobbing process, at the rate of 5.8 gears per hour. Fig. 4 shows a general view of a section of the plant and a number of the Cincinnati Gear Cutting Machine Co.'s gear-hobbers, on which the teeth are cut. Attention is again called to the spools on which the work is carried from operation to operation. In dealing with the more interesting types of gears to be described in later paragraphs, further reference will be made to these gear-cutting machines.

Roughing out the Stem Gears

Fig. 5 shows two designs of stem gears, variously referred to in automobile parlance as clutch or main drive gears. These gears are made from regular S. A. E. specification No. 2320 steel, which is a 3½ per cent nickel steel of the following composition: Carbon, 0.15 to 0.25 per cent; manganese, 0.50 to 0.80 per cent; phosphorus, not over 0.040 per cent; sulphur, not over 0.045 per cent; nickel, 3.25 to

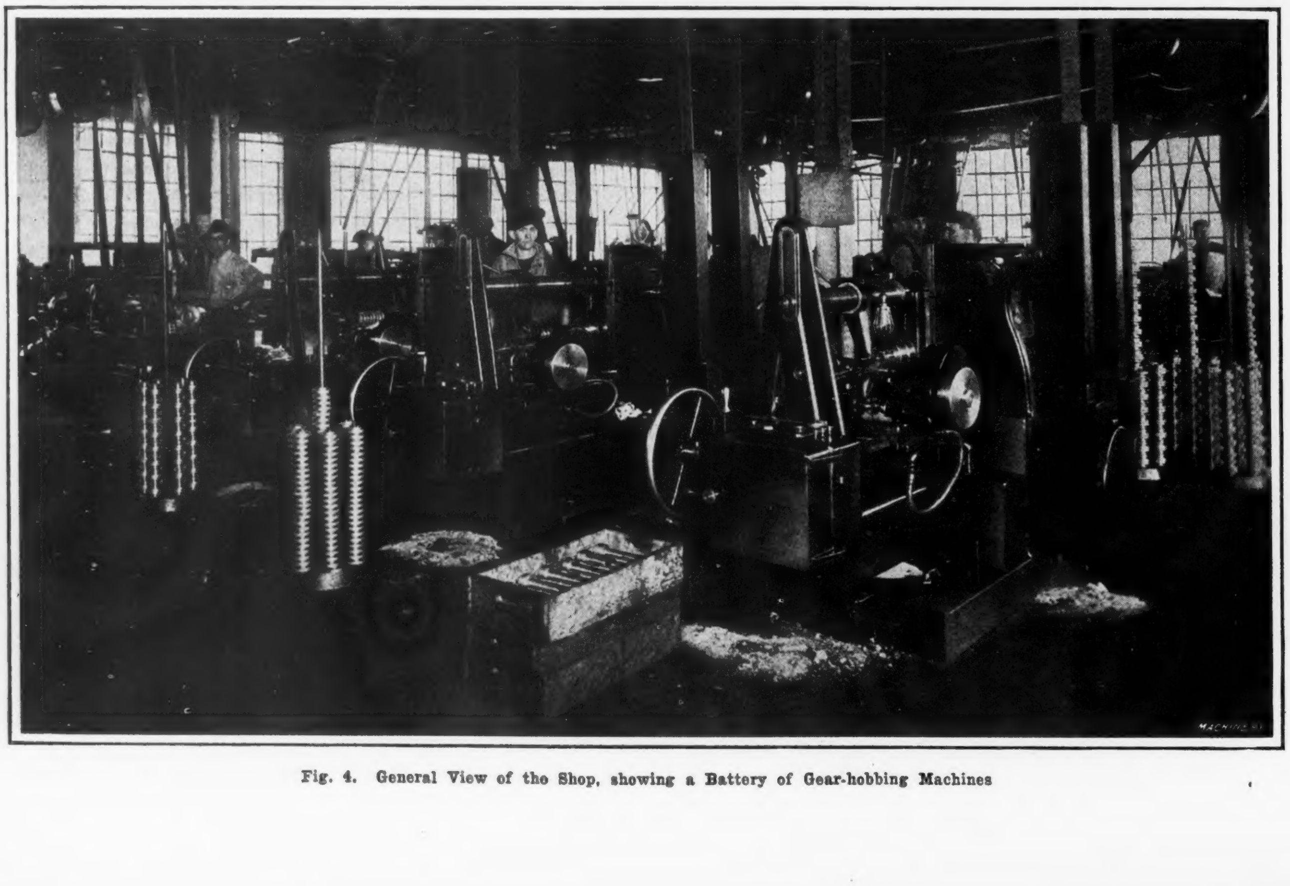


Fig. 4. General View of the Shop, showing a Battery of Gear-hobbing Machines

3.75 per cent. After the forgings have been annealed and pickled, they are then straddle-milled to length and centered on both ends, both the milling machine and the centering machine being operated by one workman. These two operations are performed at the rate of thirty gears per hour.

The roughing and finishing operations on the stem gears are performed on "Lo-swing" lathes, and the multiple tooling arrangement used is clearly illustrated in Fig. 6. This illustration shows the roughing operation on gear *A*, Fig. 5, as seen from the rear of the lathe, and is substantially the same set-up as is used for machining gear *B*. It will be evident that diameters *C*, *D*, and *E*, and the shoulders *F*, *G*, and *H*, are turned and faced with the tools with which this lathe is shown equipped, and that the finishing operations require substantially the same tooling. On the

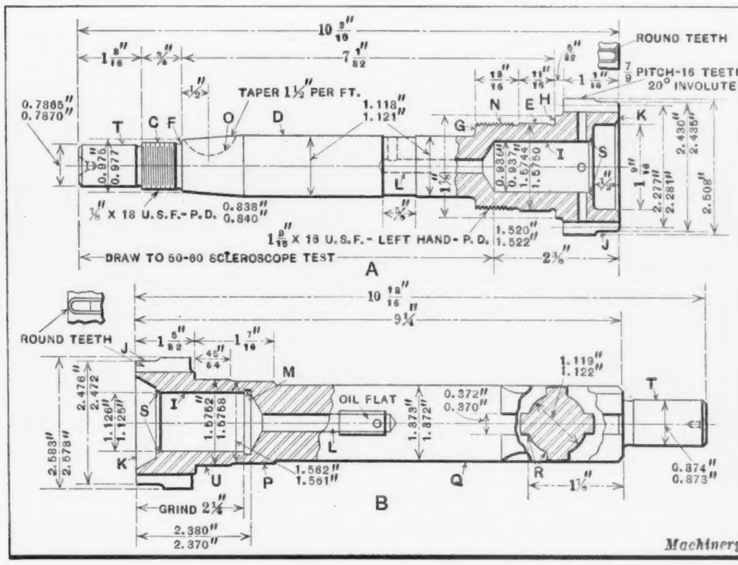


Fig. 5. Two Designs of Clutch or Main Drive Gears

holder *A*, Fig. 7; rough-counterbore hole, turn surface *J* and rough-face surface *K* with tools in station 4; finish-turn outside diameter, finish-counterbore hole, and finish-face surface *K* with tools mounted in station 5 of the turret; rough- and finish-bore hole, using head adjustment and a single-point tool in station 6; drill and ream hole *L* at stations 8 and 9. The corresponding operations on gear *B* are slightly different from these in that they include cutting recess *M* and the use of a special tool for the counterboring operation. The production time for gear *A* is 4½ parts per hour, and for gear *B*, 5½ parts per hour.

In following each machining operation on these two forgings from this point to the heat-treating process, it will be seen that in a number of minor respects the operations are different. Gear *A* is threaded at *C* and *N*, the threads being

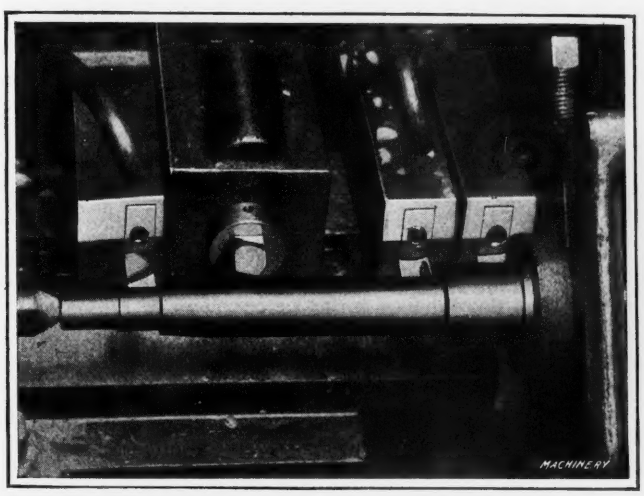


Fig. 6. Lathe showing Tooling for turning the Bearing Surfaces of a Stem Gear

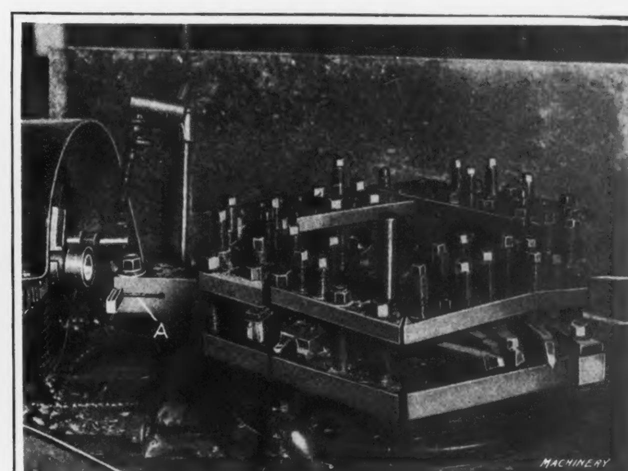


Fig. 7. Machining the Gear End of a Main Drive Shaft Gear on a Turret Lathe

finishing operations, in addition to the diameters, the recesses are machined. The production time for both roughing and finishing operations is 13.3 finished gears per hour.

After the shaft end of the gear has been finish-turned, a Jones & Lamson flat turret lathe, equipped as shown in Fig. 7, is employed to bore and finish-turn the gear end. The illustration shows this operation being performed on gear *A*, Fig. 5, and the sequence of operations and the tooling arrangement are similar to those employed in finishing corresponding surfaces of gear *B*, a fact which will be readily understood from the similarity of the two gears. The sequence of operations and the tooling are as follows: Spot and drill hole *I*, using drills in stations 1 and 2; rough-turn outside diameter with regular turning tool at station 3, carried in

chased on a Cincinnati lathe; also, a keyway *O*, in which a No. 15 Woodruff key is used, is machined on a Whitney hand milling machine. Gear *B* has two oil flats milled diametrically opposite on the long bearing surface, this operation also being performed on a Whitney hand miller. It is of paramount importance that the bearing surface of the shaft and the pitch line of the gear be concentric to within 0.003 inch, and as a means of realizing this degree of accuracy, a preliminary or "green" grinding operation is performed on surfaces *E* and *H* of gear *A* and on surfaces *P* and *Q* of gear *B*, these being the chucking surfaces by which the gears are held during the operation of finish-cutting the teeth. By following this procedure, the teeth may be used to chuck the work from the pitch line during the final grinding op-

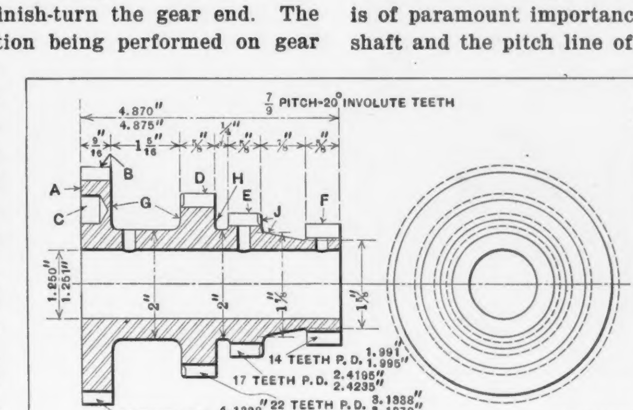


Fig. 8. Automobile Cluster Gear

erations performed on the bearing surface of the stem end after the gears have been hardened. Then, by chucking the work from these finished exterior surfaces, the bore *I* may be ground, thus assuring that all ground surfaces are concentric with the pitch circumference of the gear to within the established allowance. The "green" grinding operation is performed on a cylindrical grinder, with the work chucked on the long bearing surface, which in the case of gear *A* is also the surface utilized in chucking the work while chasing the threads at *N* and *C*. This brings the threads concentric with the other elementary surfaces of the gear. The preliminary grinding of the bearing surfaces is the final roughing operation before the teeth are cut.

Operations on Countershaft Cluster Gears Prior to Cutting the Teeth

The cluster gear shown in Fig. 8 is also made from S.A.E. No. 2320 steel, and the forging receives the same preliminary treatment as described in an earlier paragraph. The first machining operation is performed on a turret lathe, and consists of rough-facing surface *A*, squaring up surface *B*, drilling and boring the central hole, and removing the sharp corners at the ends of the hole. The production time on this series of operations is ten minutes per gear. The central hole is next broached on a Lapointe double-head broaching machine, the work being located from surface *A* of the gear, as illustrated in Fig. 9. The practice in automobile gear manufacture of finishing the holes by broaching, is followed not only in the case of cluster gears, but also on gears of all types having a central hole, such as those made from disks cut from alloy bar stock. It is stated that this method of machining produces a more satisfactory hole than reaming, and one that compares favorably with any other method of machining as regards finish.

Broaching is also an economical means of finishing round holes, because the broaching machines, which are of necessity used for machining keyways, and square or hexagonal holes, may not be kept constantly in service on this type of work, and consequently can be economically used for broaching round holes. In addition to reducing the idle time of the broaching machine, a high productive rate can be realized by this method of machining. The production time for this operation is fifty cluster gears per hour.

The cluster gears, as well as all gears which can be mounted on an arbor between lathe centers, are then straddle-faced to bring the ends parallel and at right angles to the center line of the hole. This operation is performed on an 18-inch Boye & Emmes engine lathe, the operation itself involving no work of special interest. The production

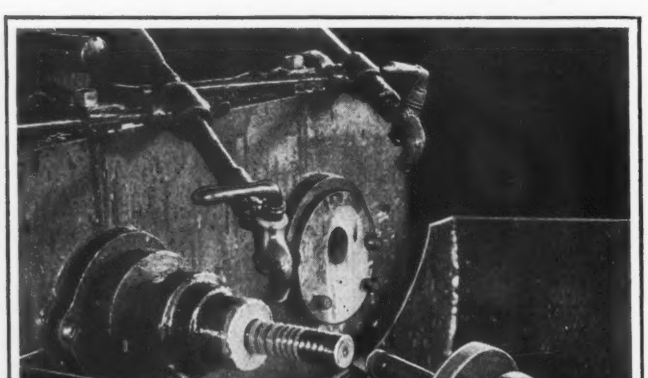


Fig. 9. Broaching Central Hole in Cluster Gear

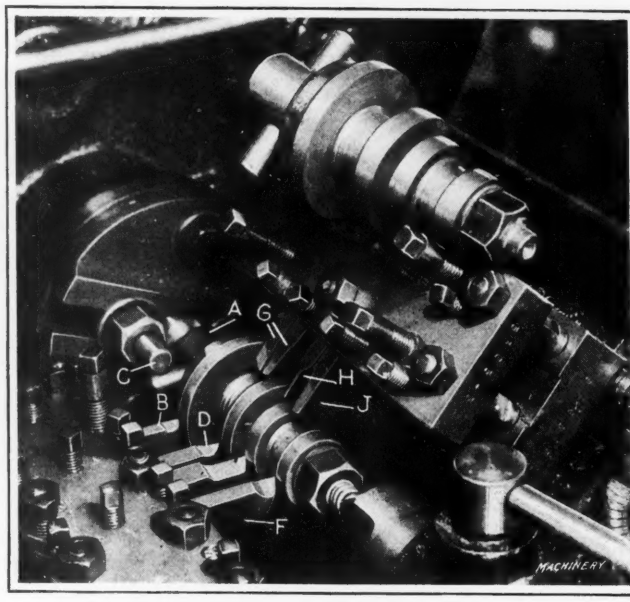


Fig. 10. Tooling Set-up of Automatic Lathe used in machining Cluster Gears

time is thirty-five pieces per hour. The next operation is drilling the drive-pin hole *C*, Fig. 8, by means of which the work is driven during subsequent machining operations. The production time is forty gears per hour.

Two Fay automatic lathes are employed in the final roughing and finishing operations, in which surfaces *B*, *D*, *E*, and *F* are rough-turned, and surfaces *G*, *H*, and *J* rough-faced on one machine; and the same surfaces are finished on the other lathe. Fig. 10 shows the tooling employed in the finishing operation, and it will be apparent that the tools *B*, *D*, *E*, and *F* perform finish-turning operations on similarly designated surfaces in Fig. 8, and that tools *G*, *H*, and *J* are facing tools for finishing the surfaces designated by these letters in Fig. 8. The arrangement of the tools is typical of that employed on all lathes of this type.

The operator takes care of both machines, and there is no idle time for either machine or operator, as the operator utilizes the time consumed in machining, by preparing to quickly unload and load the work. This is done by employing a set of three mandrels, one of which is indicated at *A*, Fig. 10; a loaded mandrel is also shown lying on top of the rear tool-holder. These have a driving pin on one end for engaging driver *C* of the faceplate, and are threaded on the opposite end so that the work may be held securely in place. As soon as the finishing operation is completed, the operator removes the mandrel and its work from the machine centers, and replaces it with the loaded mandrel, which has just been taken from the roughing machine. The third mandrel, which was loaded between cuts, is substituted for the mandrel in the roughing machine, and the operation is continued with only slight interruption. Plenty of time is afforded the operator to attend to reloading the extra mandrel and to keep a close watch on the condition of the work while the machines are running. The production time on each operation is seven gears per hour. This completes the machining work on the cluster gears prior to cutting the teeth.

In the next installment of this article the cutting of the teeth, the heat-treatment, the grinding operations performed on the gears, and the inspection will be dealt with.

* * *

Consul General Alfred A. Winslow, of Auckland, New Zealand, reports that the contract for the electrification of the Otira Tunnel on one of the New Zealand railways was recently awarded to an English electrical company in preference to a New Zealand corporation that quoted on American machinery, only because the latter's bid was higher owing to the adverse exchange rate.

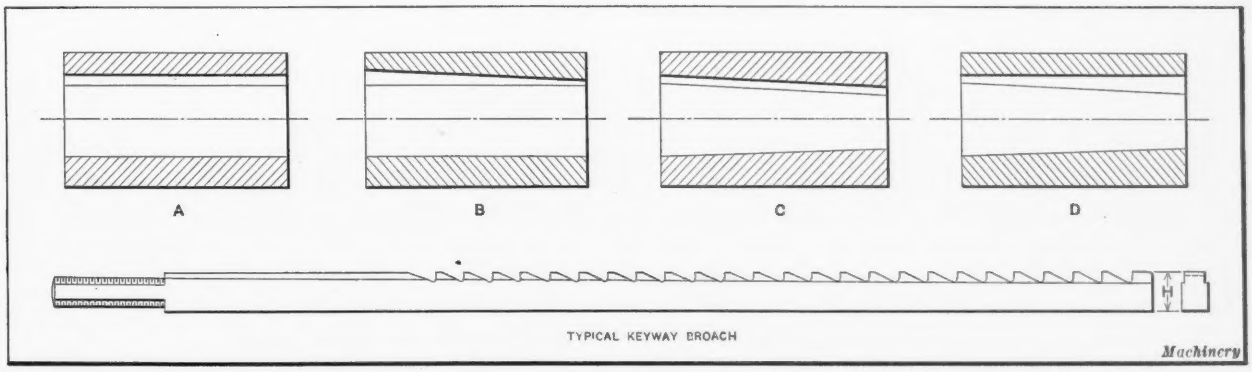


Fig. 1. Four Classes of Broached Keyways and Typical Keyway Broach

Guide Bushings for Keyway Broaching

Formulas for Designing Bushings for Broaching Accurate Keyways

By CARL H. BRIGGS

KEYWAYS may be divided into four general classes—those that accommodate straight keys in straight holes, taper keys in straight holes, straight keys in taper holes, and taper keys in taper holes. Examples of each of these are shown in section in Fig. 1, classed as *A*, *B*, *C*, and *D*, respectively. This illustration also shows a keyway broach such as is used in cutting all four classes of keyways. The guide bushings differ slightly for each class of keyway, as may be seen by referring to Fig. 3. This illustration shows the four types of guide bushings required; the work in each case is mounted on plug *P*, and the broach is guided in slot *S*.

On the dimension *T* at the bottom of these slots depends the accuracy of the depth of the finished keyway. If dimension *T* is too great, the first tooth of the broach will probably break due to overloading; but in the event of its escaping damage, the finished keyway will be too deep by an amount equal to the error. On the other hand, if dimension *T* is too small, the entering teeth of the broach will not be in the proper cutting position, and the finished keyway will be too shallow. It is the purpose of this article to present formulas by means of which dimension *T* may be readily computed.

In cases where a large amount of material is to be removed, so that it is necessary to employ two or more passages of the broach to finish the keyway, slot *S* is cut deeper, and shims are inserted under the broach after each cut, to raise it to the proper position for the next cut. The thickness of the shims should, of course, be equal to the depth of the cut taken at each pass of the broach. The amount by which the depth of slot *S* must be increased when multiple cuts are to be taken is found by the formula $(N - 1) \times C$, in which *N* equals the number of cuts required to finish the keyway to depth, and *C* the depth of each cut. In connection with the following formulas, reference should be made to the diagram Fig. 2, which represents, for straight holes, the outline of that end of the work abutting against the collar of the guide bushing (see Fig. 3). When using Fig. 2 in connection with the keyways for taper holes, it should be mentioned that the relation of elements *D*, *d*, and *a* is somewhat modified, as will be noted.

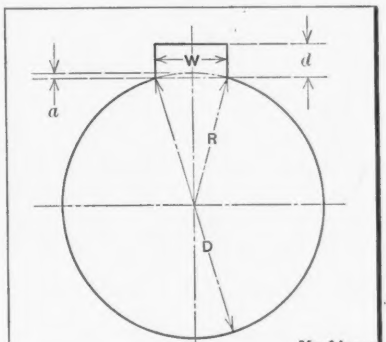


Fig. 2. Diagram showing Application of Formulas for Guide Bushings

Straight Key in Straight Hole—Class A

When only one pass of the broach is required to machine the keyway:

$$T = (D + d) - (a + H)$$

In this formula, and in all those that follow, except where noted,

T = required dimension of bushing, as indicated in Fig. 3;
D = diameter of hole;
d = depth of keyway (normal to axis);
a = height of arc (uniform); and
H = height of broach measured over finishing teeth as indicated in Fig. 1.

The formula for obtaining the height of arc *a* will be given later.

Taper Key in Straight Hole—Class B

When only one pass of the broach is required to finish the keyway,

$$T = (D + d) - \left[\sqrt{H^2 + \left(\frac{Y}{12} \times H\right)^2} + \left(\frac{Y}{12} \times L\right) + a\right]$$

in which

d = depth of keyway at deep end;
Y = taper per foot of key; and
L = length, in inches, of plug *P* (see Fig. 3).

Straight Key in Taper Hole—Class C

When only one pass of the broach is required to machine the keyway,

$$T = \left[D + \sqrt{d^2 + \left(\frac{Y}{24} \times d\right)^2} - a\right] - \left[\left(\frac{Y}{12} \times L\right) + \sqrt{H^2 + \left(\frac{Y}{24} \times H\right)^2}\right]$$

in which

D = diameter of hole at large end;
Y = taper per foot of hole;
a = height of arc at large end of bushing; and
d = depth of keyway (uniform).

Taper Key in Taper Hole—Class D

When only one pass of the broach is required to machine the keyway,

$$T = \left(D - \frac{LY}{12} + d\right) - (a + H)$$

in which

D = diameter of hole at large end;
d = depth of keyway at deep end; and
a = height of arc at small end of hole.

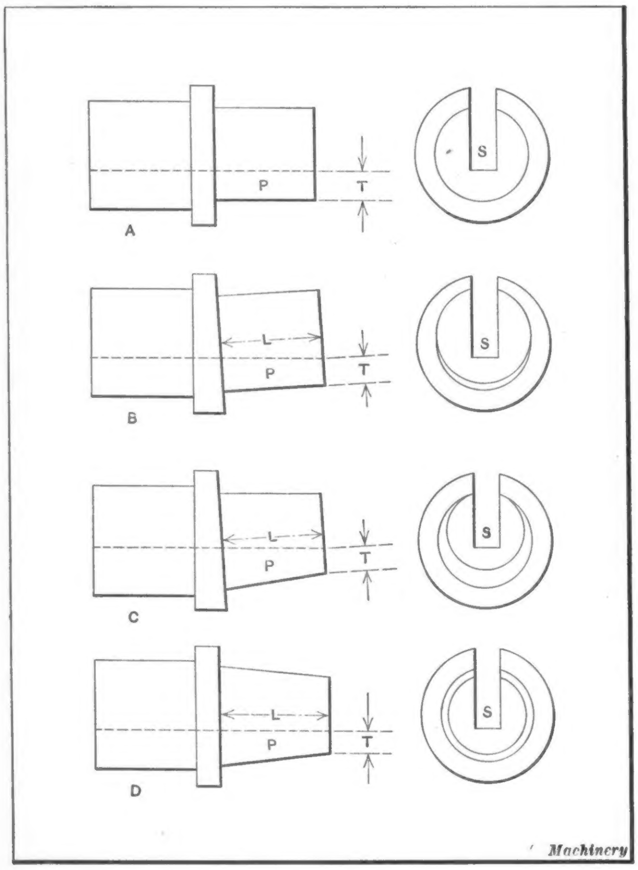


Fig. 3. Four Classes of Guide Bushings used in broaching Keyways

Height of Arc

The term "height of arc" may need a little explanation. Keyways are usually measured for depth d on the edge formed by the intersection of the side of the keyway and the hole, as indicated in Fig. 2. If the diameter of the hole is added to the depth of the keyway as measured at this point, the height of arc a will be included twice. This makes it necessary to deduct its value once, as is done in the formulas. The height of arc may be computed by the following formula given on page 500 of MACHINERY'S HANDBOOK:

$$a = R - \sqrt{R - \left(\frac{W}{2}\right)^2}$$

In this formula, the letters represent the same dimensions as in Fig. 2. When frequent use is to be made of these formulas, considerable time may be saved by arranging the various values of a in chart form. If the keyways are to be measured from the tops of the holes, the height of arc and its symbol a will not enter into the computation.

* * *

In order to show how the working rules established under federal control inflate the labor cost of railroad operation and result in great waste and inefficiency, a case was cited before the United States Railroad Labor Board in Chicago, showing that one railroad was compelled to award each man of a wrecking crew thirteen hours' pay, during which no actual service was performed. At regular and extra rates the men received thirty-seven and one-half hours pay for work all performed within twenty-four hours. Of these twenty-four hours, the men were off duty or asleep for eleven hours and were riding or eating for two hours, while receiving pay, being actually at work only eleven hours. This is not an extreme case of the unreasonable demands that labor has placed upon the railroads. Under a related rule applying to wrecking crews, claims are constantly made by men who do not actually accompany the crew but who assert that, according to the rules, they should have done so, and are therefore entitled to pay.

CALCULATING LENGTHS OF ROPE FOR DRUMS

By HYMAN LEVINE

Designers of hoists, reels, winches, etc., frequently find it necessary to compute the length of rope that can be wound on a given size drum. If the diameter of the drum flange is such as to allow but one layer of rope, the computation is simple enough, being obtained by multiplying the circumference of one coil by the number of coils in the layer. However, if the flange diameter is increased or the rope diameter decreased, so that there will be more than one layer of rope on the drum, as shown in the illustration, the problem becomes more complicated. In the following, the lengths of rope will be calculated as if each coil were an individual ring rather than all of them one continuous piece of rope. This method will cause an error due to the helical winding of the rope, but the calculations will be sufficiently accurate for all practical purposes; the larger the drum, the less this error will be.

In the various formulas to be presented,

d = diameter of rope, in inches;
D = diameter of drum, in inches;
F = diameter of drum flange, in inches;
W = width of drum, in inches;
P = pitch between coils, in inches;
C = number of coils in the first layer;
A = average number of coils per layer;
N = number of layers;
T = total number of coils;
M = mean diameter of rope coil in inches;
R = fractional remainder obtained in calculating the product of $W \div d$; and
L = total length of rope, in feet, that can be wound on drum.

By reference to the illustration, it will be evident that

$$L = \frac{\pi MT}{12}$$

The difficulties encountered in problems of this nature lie in determining the values of M and T. The number of layers N depends upon the diameter of the rope and on the difference in diameter between the drum flange and the portion of the drum on which the rope is wound. It will be apparent that the pitch diameter of the first layer, that is, the layer

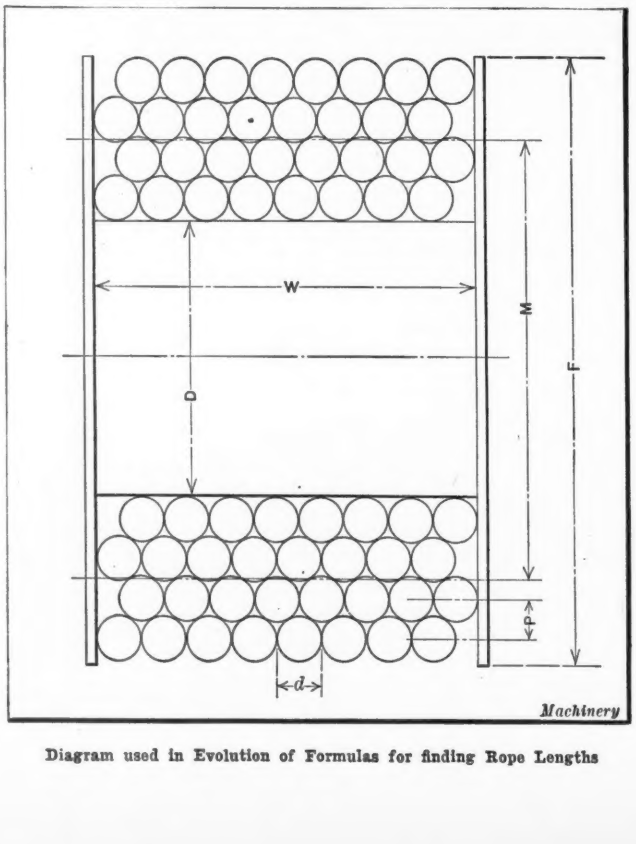


Diagram used in Evolution of Formulas for finding Rope Lengths

adjacent to the drum proper, equals $D + d$; that of the second layer, $(D + d) + 2P$; that of the third layer, $(D + d) + 4P$; and so on, the pitch diameter increasing an amount equal to the value of $2P$ with each additional layer. The number of spaces between the first and the last coils equals

$$\frac{F - (D + d)}{2P}$$

This number is, of course, one less than the total number of layers because the first layer has not been included; however, in order to insure that the last layer of coils will not be too far beyond the edge of the flange, add 0.5 to this result to find the number of layers on the drum, instead of adding 1. Thus,

$$N = \frac{F - (D + d)}{2P} + 0.5$$

The result will usually contain a decimal, but the number of layers should be taken as the nearest whole number. By making the necessary trigonometrical calculations it will be evident that

$$P = \frac{d}{2}\sqrt{3}$$

The equation for finding the number of layers can then be reduced as follows:

$$N = \frac{F - D - d}{1.732d} + 0.5 \qquad (1)$$

It is evident that the mean diameter of the rope coils M is equal to the pitch diameter of the first layer $(D + d)$ plus one-half the distance from the center of this layer to that of the last layer. Thus,

$$M = D + d + 0.866d\ (N - 1) \qquad (2)$$

The total number of coils T depends upon the width of the drum and the diameter of the rope. The number of coils in the first layer can be found by the equation

$$C = \frac{W}{d} \qquad (3)$$

In this calculation, it will be necessary to discard the fractional remainder R because it is impossible to have a fraction of a coil. The number of coils in the second layer varies with the value R; if R is equal to, or greater than, 0.5 there will be the same number of coils in each of the other layers as in the first, and $T = NC$, but if R is less than 0.5 every second layer will have one coil less than the first and $A = C - 0.5$ when the number of layers is even, and $A = C - \frac{N - 1}{2N}$ when the number of layers is odd. Also $T = N\ (C - 0.5)$ in the first case, and $T = N\left(C - \frac{N - 1}{2N}\right)$ in the last.

The different formulas evolved to satisfy the various conditions entering the calculation of the rope length for a given drum are as follows:

$$L = \frac{\pi MNC}{12}, \text{ when } R \text{ is equal to, or greater than, 0.5 inch.} \qquad (4)$$

$$L = \frac{\pi MN}{12}\ (C - 0.5), \text{ when } R \text{ is less than 0.5 inch and } N \text{ is even,} \qquad (5)$$

And

$$L = \frac{\pi MN}{12}\left(C - \frac{N - 1}{2N}\right), \text{ when } R \text{ is less than 0.5 inch and } N \text{ is odd.} \qquad (6)$$

The following examples will illustrate the procedure followed in calculating a rope length.

Example—Find the length of rope that can be wound on a drum 12 inches in diameter, 6 inches wide, having an 18½-inch diameter flange, the rope being ⅜ inch in diameter.

Inserting the known values in Equation (1),

$$N = \frac{18.5 - 12 - 0.375}{1.732 \times 0.375} + 0.5 = 9.9 \text{ or } 10 \text{ layers}$$

Next, according to Equation (2)

$$M = 12 + 0.375 + 0.866 \times 0.375 \times 9 = 15.3 \text{ inches}$$

Solving Equation (3) to find the number of coils,

$$C = 6 \div 0.375 = 16$$

In this calculation, $R = 0$, and, as the number of layers is even, according to the conditions explained in the foregoing, Equation (5) should be used in calculating the length of rope for this drum. Therefore,

$$L = \frac{3.14 \times 15.3 \times 10}{12} \times 15.5 = 620.5 \text{ feet}$$

If the width of the drum in this problem is assumed to be 6¼ inches, C would equal 16.6; as R is greater than 0.5 inch in this case, Equation (4) should be employed in determining the rope length. Thus,

$$L = \frac{3.14 \times 15.3 \times 10 \times 16}{12} = 640.6 \text{ feet}$$

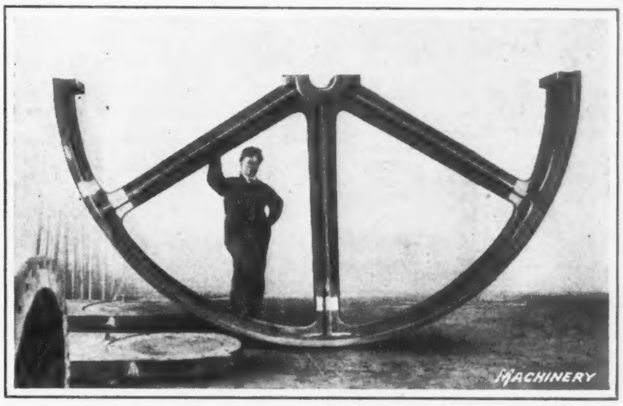
If the drum width is again considered as 6 inches, but the flange diameter is reduced to 18⅛ inches, $N = 9$, and $M = 14.97$ inches. The number of layers is odd in this case, and as R is less than 0.5 inch, Equation (6) should be used for the solution. Thus,

$$L = \frac{3.14 \times 14.97 \times 9}{12} \times 15.55 = 548.4 \text{ feet}$$

* * *

LARGE FLYWHEEL REPAIR

A large flywheel, as shown in the accompanying illustration, was recently repaired at the Newark welding shop of the Oxweld Acetylene Co. This flywheel was shipped to Newark, N. J., by a firm in Richmond, Va. The wheel is 18 feet in diameter, the spokes being 8½ by 5 inches in cross-section at the rim, which is 25 inches wide by 2 inches thick; and the hub is 18¼ inches long with a bore 9 inches in diameter. The rim was broken apart in one place, and all three spokes of the broken half wheel were snapped off short at the rim. The other half of the wheel, which was unbolted before shipping, remained intact. The illustration shows the job in its completed form, the welded parts being indicated by white chalk marks. Preparation for welding and the actual welding required fifty-seven and one-half hours. The cost was a small part of what would have had to be paid for a new casting, and the saving in time was an even greater economy.



Large Flywheel repaired by Oxy-acetylene Welding

* * *

Steel rails laid down on the railroads of the United States in 1920 cost approximately $48 a ton—an increase of 20 per cent over the cost in 1919, and 63 per cent over the cost in 1911. Cross-ties for railroads cost 32 per cent more in 1920 than in 1919, and 153 per cent more in 1920 than in 1911.

Steels for Machine Tool Parts*

By ROBERT M. TAYLOR, Works Engineer, The American Tool Works Co., Cincinnati, Ohio

THERE has not been much information published to indicate to machine tool builders what materials are generally used by the machine tool industries. In most cases a selection of material is made by conferring with the steel mill salesmen. This method may have its advantages, but it has resulted in the same material being called by many different names. When a buyer tried to buy a material from a different source, it was a difficult task to juggle the trade names, analyses, and physical specifications to get a comparison. The automobile manufacturers met with the same difficulties, and early in their career they clearly saw the advisability of preparing uniform specifications and classifications for materials, and through the American Society of Automotive Engineers developed the S. A. E. specifications for steels.

Steels of S. A. E. specifications are now being manufactured by practically all steel mills, and if the same or similar classifications were adopted by other industries it would greatly simplify the difficulties of buyers and steel manufacturers. In the numbers used in the S. A. E. system, the first figure indicates the class to which the steel belongs: thus, 1 indicates a carbon steel; 2, nickel; 3, nickel-chromium; 5, chromium; 6, chrome-vanadium; and 9, silico-manganese. In the case of alloy steels, the second figure generally indicates the approximate percentage of the predominant alloying element. The last two or three figures indicate the average carbon content in points or hundredths of one per cent, thus 3120 indicates a nickel-chromium steel with approximately 1 per cent nickel (1.00 to 1.50 per cent) and 0.20 per cent carbon (0.15 to 0.25 per cent). Also, 1020 indicates a straight carbon steel containing approximately 0.20 per cent carbon (0.15 to 0.25 per cent). The heat-treatments have also been standardized, letters being used to designate the different kinds. These heat-treatments are given in detail on pages 1156 and 1157 of MACHINERY'S HANDBOOK.

For the benefit of buyers, draftsmen, and shop men in the machine tool industry, a list of steels suitable for many parts used extensively in the construction of machine tools is presented. While these steels are identified by S. A. E. numbers and letters, they correspond to the same grades of steel supplied under various names. The physical properties given have been secured from the best information available, but all are not results of actual tests.

COMPOSITION AND HEAT-TREATMENTS OF STEELS FOR MACHINE TOOL PARTS

Use in Machine Tools	Kind of Steel	S.A.E. Specification Numbers	Carbon, Per Cent		Manganese, Per Cent		Phosphorus, Per Cent Max.	Sulphur, Per Cent Max	Nickel, Per Cent		Chromium, Per Cent		Vanadium Per Cent		Silicon, Per Cent		Heat-treatments
			Maximum and Minimum	Desired	Maximum and Minimum	Desired			Max. and Min.	Desired	Max. and Min.	Desired	Max and Min.	Desired	Max. and Min.	Desired	
Shafting; Soft and Carburized Gears; Keys	Carbon steel	1020	0.15–0.25	0.20	0.30–0.60	0.45	0.045	0.05	.....	....	....	....	...	...	.....	....	A-B-H
Spindles, Arbors; Special Shafts; Tempered Gears	Carbon steel	1045	0.40–0.50	0.45	0.50–0.80	0.65	0.045	0.05	.....	....	....	....	...	...	.....	....	D-E-H
Centers and Springs; Cams; Mandrels	Carbon steel	1095	0.90–1.05	0.95	0.25–0.50	0.35	0.04	0.05	.....	....	....	....	...	...	.....	....	F-X
Screws; Nuts; Bolts; Studs	Screw stock	1114	0.08–0.20	....	0.30–0.80	....	0.12	0.06–0.12	.....	....	....	....	...	...	.....	....	A
Lead-screws	Lead-screw stock	1135X	0.30–0.40	0.35	0.60–0.90	0.75	0.07	0.06–0.09	.....	....	....	....	...	...	.....	....	....
Carburized Gears	Nickel-chromium steels	3120	0.15–0.25	0.20	0.50–0.80	0.65	0.04	0.045	1.00–1.50	1.25	0.45–0.75	0.60	...	...	.....	....	D-G-H
Tempered Gears; Spindles; Toolpost Screws; High-duty Shafts	Nickel-chromium steels	3135	0.30–0.40	0.35	0.50–0.80	0.65	0.04	0.045	1.00–1.50	1.25	0.45–0.75	0.60	...	...	.....	....	D-E-H
Oil-hardened Gears; Cams; Ratchets	Nickel-chromium steels	3250	0.45–0.55	0.50	0.30–0.60	0.45	0.04	0.04	1.50–2.00	1.75	0.90–1.25	1.10	...	...	.....	....	M-Q
Ball Races; Rollers; Cams; Pins	Chromium steels	5195	0.90–1.05	0.95	0.20–0.45	0.35	0.03	0.03	....	...	0.90–1.10	1.00	...	....	.....	....	M-P-R
Carburized Gears	Chromium-vanadium steels	6120	0.15–0.25	0.20	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	S-T
Spindles; Tempered Gears; Shafts	Chromium-vanadium steels	6135	0.30–0.40	0.35	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	T-U
Oil-hardened Gears; Springs	Chromium-vanadium steels	6150	0.45–0.55	0.50	0.50–0.80	0.65	0.04	0.04	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	U
Balls; Cones; Ball Races	Chromium-vanadium steels	6195	0.90–1.05	0.95	0.20–0.45	0.35	0.03	0.03	.....	....	0.80–1.10	0.95	0.15	0.18	.....	....	U
Springs; Gears	Silico-manganese steels	9250	0.45–0.55	0.50	0.60–0.80	0.70	0.045	0.045	.....	....	....	....	...	...	1.80–2.10	1.95	V
Springs; Gears	Silico-manganese steels	9260	0.55–0.65	0.60	0.50–0.70	0.60	0.045	0.045	.....	....	....	....	...	...	1.50–1.80	1.65	V

Machinery

Steel for Shafts and Spindles

Shafting—Steel 1020 is generally used either in the cold-rolled state or turned and ground. When used in the cold-rolled state it has a disadvantage in some cases where long keyways are to be cut, due to the fact that the keyway relieves the surface tension and causes the shaft to buckle or become untrue. Steel 1045 can be used for shafting requiring greater strength.

Spindles—Steel 1045 made by the crucible process is most generally used. This material can be heat-treated to increase the strength when desired, treatments D, E, or H being satisfactory. Steel 3135 made by the open-hearth

* Abstract of a paper published in the Transactions of the American Society for Steel Treating.

process in such quantities as to insure uniformity has been popular with concerns demanding a high-grade alloy steel spindle. It has not been the practice to heat-treat this material for ordinary spindles, but the steel improves so much with heat-treatment that it is advisable to heat-treat in all cases, especially if there are any keyways or shoulders on the part. Some concerns run the hardness up to 60 scleroscope and finish machining after heat-treating, but in general practice a hardness of from 38 to 45 scleroscope is best, because when the degree of hardness is too great, the cutting becomes difficult. Treatments D, E, or H are used. Steel 6135 is suitable for spindles in extreme cases where vibration and alternate stresses are severe, but it should always be heat-treated to a hardness of from 38 to 45 scleroscope, treatment T or U being used.

Steel for Gears and Cams

Gears—For gears intended to operate at low speeds and carry light loads, steel 1020 is used in the soft state. For gears of low speeds and heavy loads the following steels, heat-treatments, and degrees of hardness are suitable: 1045-H up to 65 scleroscope hardness; 3135-H up to 65 scleroscope hardness; 6135-T up to 65 scleroscope hardness. For gears of high speeds and light loads the following steels may be used: 1020-A or 1020-B up to 95 scleroscope hardness; 3120-G up to 95 scleroscope hardness; and 6120-T up to 95 scleroscope hardness. For gears of high speeds and heavy loads, use 3250-M or 3250-Q at from 72 to 80 scleroscope hardness; 6150-U at from 72 to 80 scleroscope hardness; or 9260-V at from 72 to 80 scleroscope hardness.

Cams—Where no severe strains are imposed on light sections, steel 1095-F or 1095-X can be used with a hardness up to 90 scleroscope. Where greater strength is required, use 3250-Q up to 85 scleroscope hardness. Where extreme hardness is required, use 5195-Q up to 100 scleroscope hardness, 6195-U up to 100 scleroscope hardness or 9260-V up to 100 scleroscope hardness.

Steel for Miscellaneous Machine Tool Parts

Centers—Steel 1095-X is almost universally used, heating the head in a lead pot and quenching in water to a hardness of from 90 to 100 scleroscope.

Lead-screws, etc.—Steel 1135-X is often used for lead-screws, etc., because of its free- and smooth-cutting properties. Sometimes 1020 is used, but it is not advisable except for very light duty, 1045 being better. Sulphur in this stock should not be less than 0.06 per cent.

Thrust Washers—Steels 1020 or 3120 with the carburizing treatment B are used for light service, and 1095-X, 3250-Q, and 5195-R, for heavy service.

Ball Races, Rollers, and Pins—Steel 5195-R is most used for this service, with a hardness of 80 to 100 scleroscope.

Springs—Steel 1095-F is generally used, and steels 6150-U, 9250-V, and 9260-V for severe service.

Keys—Steel 1020 in a cold-rolled condition is frequently used, but it is not recommended except where an extremely low price is desired. Steel 1045 in a tempered condition is much preferable, because of its ability to resist distortion. Steel 3250-M is used for sliding keys, etc., when a wear-proof key with great strength is required.

Bolts, Nuts, Pins, Studs and Screws—Steel 1114 is especially made to permit rapid screw machine production with a smooth finish, strength being a secondary consideration. This material can be carburized by treatments A or B. Steel 1020 will give much greater strength both in soft and carburized screws, being also carburized by treatments A or B. Steel 1045-H can be used for a tempered screw.

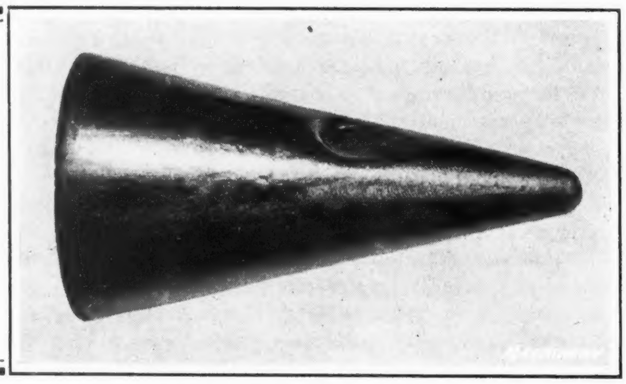
Toolpost Screws, etc.—For screws of extreme strength, steels 3120-B or 3135-H will give best results if the hardness is not above 65 scleroscope.

PROPERTIES OF STEELS FOR MACHINE TOOL PARTS

Use in Machine Tools	Kind of Steel	Properties of Annealed Steel					Properties of Cold-drawn or Cold-rolled Steel					Properties of Heat-treated Steel						
		Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Elastic Limit, Pounds per Square Inch	Ultimate Strength, Pounds per Square Inch	Reduction in Area, Per cent	Elongation in 2 Inches, Per cent	Brinell Hardness	Shore Hardness	Drawing Temperature
Shafting; Soft and Carburized Gears; Keys..............	Carbon steel	Yield 30,000	40,000	60	30	...	Yield 40,000 60,000	.....	35 30	..	...	50,000	80,000	60	20	180	34	400
Spindles; Arbors; Special Shafts; Tempered Gears...	Carbon steel	50,000	70,000	45	22	...	60,000	70,000	35	18	...	80,000 90,000	115,000 125,000	42 35	16 12	250 300	41 45	800 400
Centers; Springs; Cams; Mandrels	Carbon steel	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	90,000 180,000	Transverse-Test				60 70	900 400
Screws; Nuts; Bolts; Studs..	Screw stock	Yield 20,000 30,000	....	.. ..	.. ..	... ...	30,000 40,000	60,000 90,000	58 42	36 17	... ...	....	....	.. ..	.. ..	... ...	.. ..	... ...
Lead-screws	Lead-screw stock	50,000	80,000	60	30	170	Hot-rolled—Unannealed 60,000	100,000	50	20	200	......	......	..	..	...	..	...
Carburized Gears	Nickel-chromium steels	30,000 40,000	80,000	55 40	35 25	140	50,000 60,000	90,000	55	27	170	......	......	..	..	...	..	...
Tempered Gears; Spindles; High-duty Shafts; Toolpost Screws	Nickel-chromium steels	45,000 60,000	85,000	45 30	25 15	160	55,000	95,000	50	25	200	135,000 190,000	150,000 210,000	38 25	15 8	330 448	52 72	900 500
Oil-hardened Gears; Cams; Ratchets	Nickel-chromium steels	70,000	100,000	60	25	180	.....	.....	..	..	...	160,000 210,000	180,000 270,000	48 25	14 10	350 480	57 78	900 500
Carburized Gears	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	55,000 100,000	....	65 45	25 10	... ...	28 40	1300 600
Spindles; Tempered Gears; Shafts	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	100,000 125,000	....	55 25	15 5	... ...	35 72	1300 350
Oil-hardened Gears; Springs	Chromium-vanadium steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	150,000 240,000	....	35 15	10 2	... ...	.. ..	550 350
Springs; Gears	Silico-manganese steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	60,000 180,000	....	40 10	20 5	... ...	.. ..	... ...
Springs; Gears	Silico-manganese steels	....	....	.. ..	.. ..	... ...	....	....	.. ..	.. ..	... ...	60,000 180,000	....	40 10	20 5	... ...	.. ..	... ...

Machinery

Dies for Producing a Conical Part



Operations in Manufacturing a Difficult Shell

By N. T. THURSTON
The Acklin Stamping Co., Toledo, Ohio

THE production of conical-shaped parts of the type illustrated in the heading illustration was successfully accomplished by eleven operations performed on power presses equipped with a number of interesting dies. The part is the rear cap or tail-piece of incendiary bombs manufactured in large quantities for the United States Government during the war. This piece was first made by cutting out the blank on a power press, then rolling it into a conical shape, and finally welding the ends together in a seam by the oxy-acetylene process. This method was thought to be the ideal one for the manufacture of this part, as a drawing and forming proposition was considered out of the question, mainly because of the difficulty that would be encountered in drawing the piece to a point without, at the same time, decreasing the metal thickness at the point.

The manner in which the part was ultimately drawn satisfactorily without necessitating the punching of a hole through the point is described in the following. The question of production was also believed to be against manufacturing the part by the use of dies, but an output of 500 finished pieces per hour was maintained throughout a lot of 35,000 pieces. This production was, of course, much greater than that obtained when the parts were manufactured by the method requiring the welding operation.

Material and Lubricant Used for Parts

All the operations were performed on straight-sided single-action presses. Two annealing operations between certain of the drawing operations, and the allowance of proper reductions on the part and radii on the dies were the means by which success was attained. The strip steel used was a good drawing quality, 0.065 inch thick by 5¼ inches wide, hot-rolled, pickled, and oiled. In purchasing the steel for the job, care was taken to see that the gage would run even. The use of stripped steel permitted increased production and made handling easier.

Several kinds of lubricants were tried out to obtain one that would prevent the tools from heating and wearing excessively. Special interest was taken in a soap and water solution; by mixing in the proportion of one part soap to eight parts of cold water, a satisfactory lubricant was secured, which also acted as a cleanser by removing the scale and dust particles remaining in the shell that tumbling failed to remove. The removal of this scale lessened the wearing of the tools to some extent, and the soap-and-water solution may well be recommended for similar jobs.

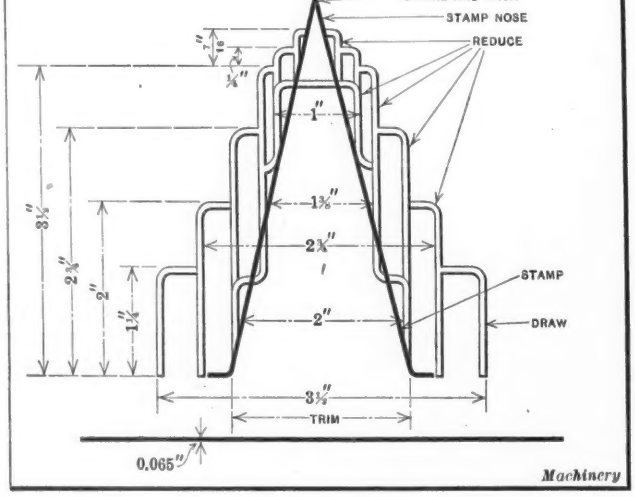


Fig. 1. Lay-out made to determine Approximate Number of Operations Necessary

Fig. 1 shows the method employed to determine the approximate number of operations and the reduction necessary to bring the piece to the required shape. During the experimental stages the first operation consisted simply of cutting the circular blank. After the correct blank size had been determined, the first operation was performed in a combination die, which cut the blank and then drew it to the shape shown above the blank at *A*, Fig. 2. This combination die is shown in Fig. 3, and was used on a No. 73½ Bliss press, being mounted on a cast-iron base *A*. The tool-steel ring *B*, which constitutes the cutting edge of the die, is forged on a machine-steel plate fastened to the cast-iron base. The tool-steel draw-ring or blank-holder *C* is carried on the top of four cold-rolled ¾-inch pins *D*, which are equally spaced under the ring and supported by rubber buffers underneath the die. The lower end of punch *E* is also made of tool steel and this part is then forged to a machine-steel shank.

When the punch descends on the downward stroke of the press, the blank is cut as the punch enters ring *B;* it is pressed against draw-ring *C*, and finally drawn over the tool-steel plug *F* to the desired form. During this step, pins *D* are forced down on the rubber buffers previously referred to, and on the return stroke of the press, the buffers force the pins up through the die, thus raising the draw-ring and forcing the part from plug *F*. The knock-out pin *G* placed in the center of the punch, is forced downward on the upward stroke of the punch, and ejects the part from the punch if it adheres. This movement of the knock-out pin is effected by an attachment secured to the press. A rod entering the tapped hole *H* in the base holds the buffers under the press. Vents are provided in both the punch and the die parts to allow confined air to escape during the drawing of the cup.

At *B* in Fig. 2 is shown a piece after the second operation, which is performed by the die illustrated in Fig. 4, in which the diameter of the piece is reduced ¾ inch, while the depth is increased 1 1/16 inches. This die is mounted on a machine-steel base *A*, secured to a No. 56 Toledo press. Plug *B*, punch *C*, and draw-ring *D* are made of tool steel, and are hardened and ground. Vents are again provided in the plug and punch to allow confined air to escape from under the descending cup, thus avoiding bulging and wrinkling of the piece. The draw-ring is supported by pins mounted on a rubber buffer, which strip the work from plug *B*. A knock-out device is also provided in the punch.

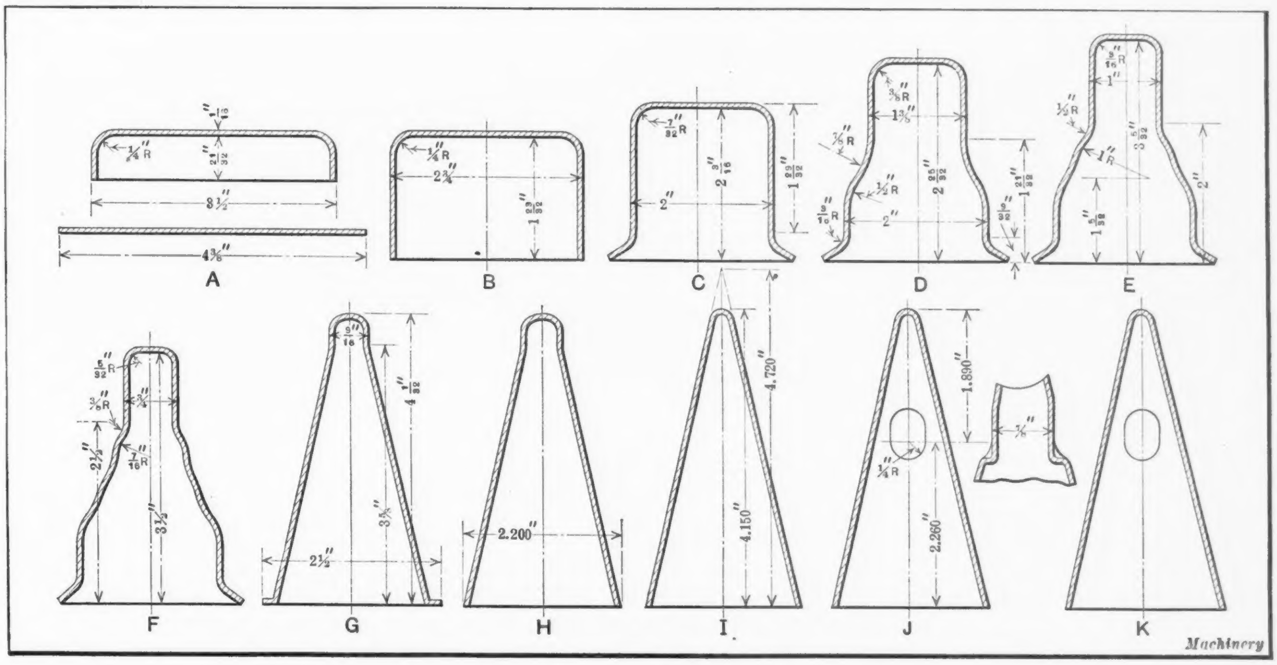


Fig. 2. Shape and Dimensions of the Shell after Each of the Operations

Successive Reducing Operations on the Shell

Prior to the third operation the parts are dipped into a solution consisting of one part of muriatic acid to five parts of water. This loosens the scale which forms on the surface of the steel during the subsequent process of annealing. The parts are then annealed by heating them to a cherry-red. It is an easy matter to remove the loose scale by tumbling, this removal being essential in prolonging the life of the wearing parts of the die. The annealing process releases all internal strains set up in the work during the first two drawing operations and prepares the piece for further drawing. The third operation is performed on a No. 56 Toledo press equipped with the die illustrated in Fig. 5 which draws the part to the shape shown at *C*, Fig. 2. A reduction of 3/4 inch is made in the diameter during this operation, and the depth is increased 15/32 inch. The base of the part is now the proper size for the final drawing, and is held at this diameter during the next three operations. This die is practically like the one preceding it, in construction and operation.

Fig. 2, at *D*, shows the piece after it has been put through the fourth operation, which is performed by the die shown in Fig. 6, mounted on a No. 58 Toledo press. In this operation the diameter of the nose is reduced 5/8 inch, while the length of the part is increased 19/32 inch. The construction of this die is similar to the preceding ones. The next reducing operation produces the shape shown at *E*, Fig. 2, the die employed being illustrated in Fig. 7. The diameter of the nose is decreased 3/8 inch, while the depth of the shell is increased 3/8 inch. By keeping the increase in depth in the correct proportion to the decrease in diameter, the tendency to stretch the material is almost entirely overcome, and the desired thickness of the part is maintained. This die was mounted on a No. 74½ Bliss press.

The last of the reducing operations brings the piece to the shape shown at *F*, Fig. 2. The die used is shown in Fig. 8, it being mounted on a No. 84 Bliss press. It will be seen that it is quite similar to the dies previously described. The stampings are again annealed, before this operation. By means of the two annealing operations the part is produced satisfactorily with a minimum of breaking and tearing. The piece was given several other annealings during the experimental stage, but these were omitted during production without any undesirable effects.

Tapering the Cone, Reducing the Nose, Forming the Flange, and Trimming the Shell

The seventh operation tapers the sides of the cone, reduces the diameter of the nose, and forms a flat flange at the face, as shown at *G* in Fig. 2. This is done on a No. 58 Toledo press equipped with the die illustrated in Fig. 9. The previous annealing operations have relieved all internal strains in the metal and have somewhat softened it so that the production of a cone with uniform sides is possible. A rather interesting feature of this die is the construction

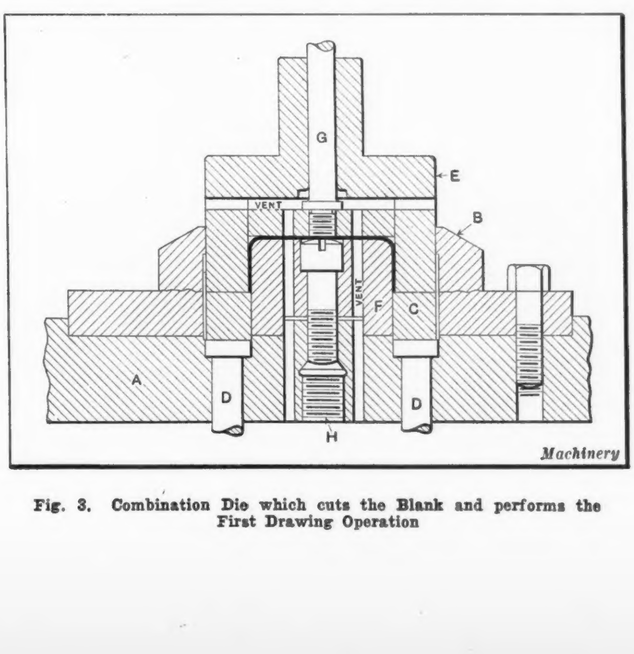


Fig. 3. Combination Die which cuts the Blank and performs the First Drawing Operation

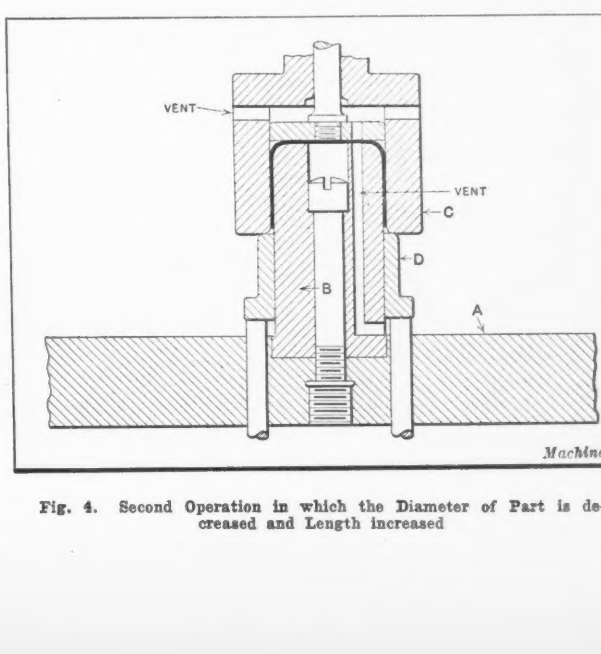


Fig. 4. Second Operation in which the Diameter of Part is decreased and Length increased

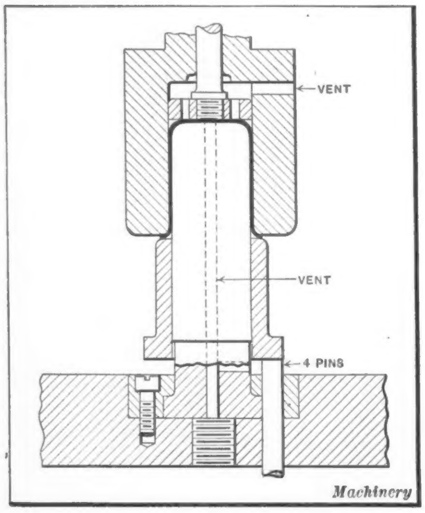


Fig. 5. Die used in Next Reduction on Part

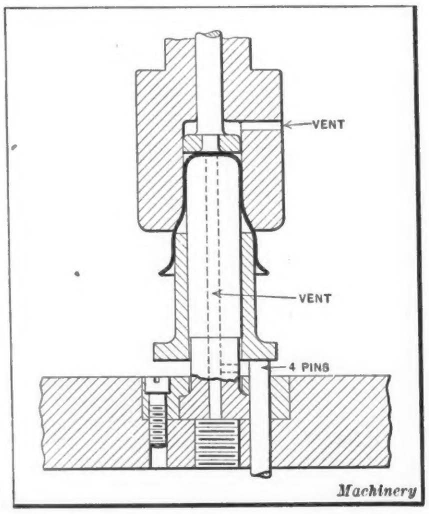


Fig. 6. Further Reduction of the Nose Diameter

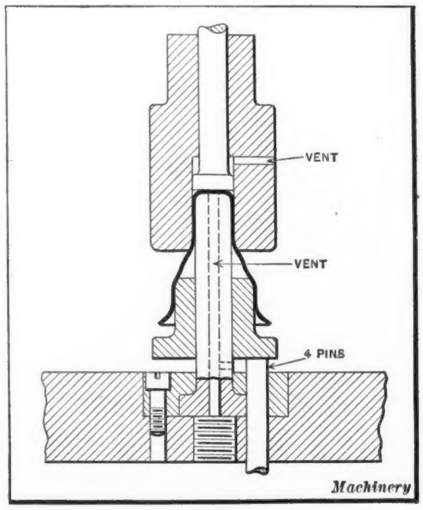


Fig. 7. Next Step in the Reduction of the Conical Shell

of the plug upon which the part is shaped; this is made of two tool-steel pieces *A* and *B*. The plug was formerly made of one piece, but considerable trouble was experienced with this construction, because of the fact that the plug would wear away rapidly about one inch from the top so that an annular depression was formed. Several different kinds of steel, tempered to various degrees of hardness were ex-

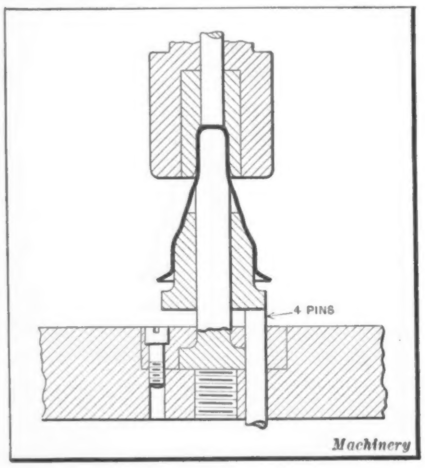


Fig. 8. Final Reducing Operation on the Part

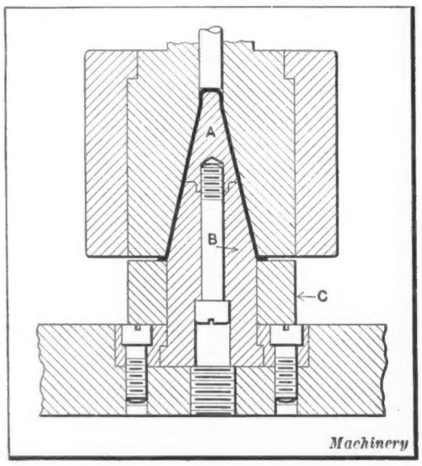


Fig. 9. Tapering the Cone and forming the Flange

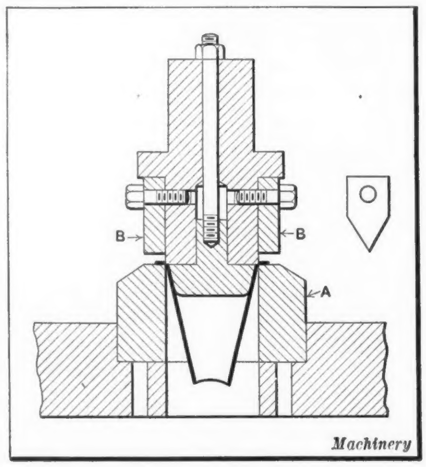


Fig. 10. Trimming the Flange from the Base

perimented with, but with little success. However, the problem was satisfactorily solved by the construction illustrated. Plug *A* is fastened to plug *B* by a screw that fits in a hole running through the center of plug *B*. When the upper plug becomes so worn that the work does not pass inspection, it is removed and another fastened into place. A supply of these tips is made up and kept on hand so that the production of the part is not greatly interfered with when substitution is necessary. Draw-ring *C* is supported on pins (not illustrated), which are used in connection with rubber buffers, as on the dies previously described.

The eighth operation is performed on a No. 77 Toledo press equipped with the die shown in Fig. 10, which trims the part as shown at *H*, Fig. 2. The flat flange produced during the previous operation permits the cone to rest evenly in an inverted position on the top surface of the trimming die *A*. Two cutters *B* are fastened on opposite sides of the punch above the trimming edge, for the purpose of cutting in two, the trimmed-off scrap rings which accumulate around the punch. Holes are drilled in the base beneath die-part *A* to facilitate the removal of the part.

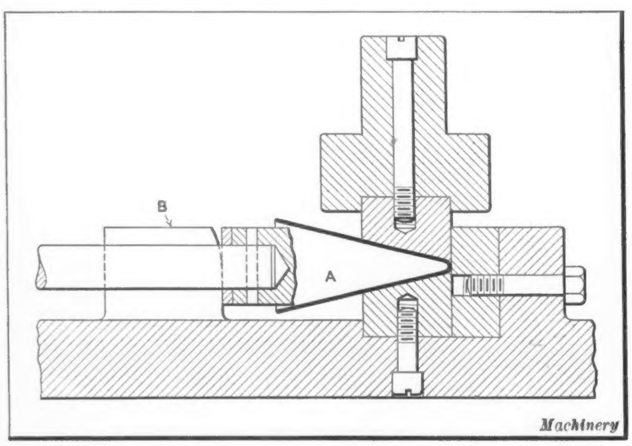


Fig. 11. Die employed to form the Point on the End of the Conical Shell in Four Strokes

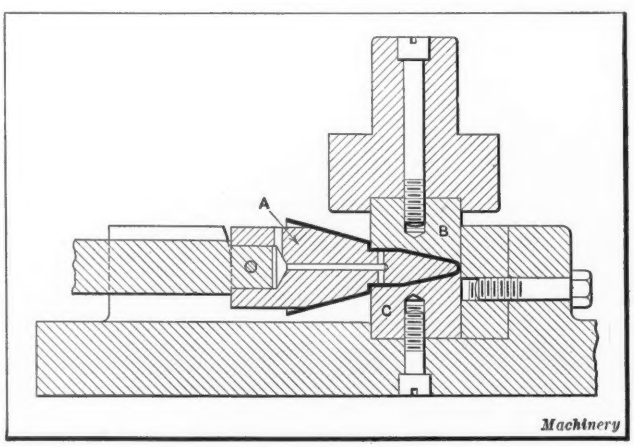


Fig. 12. Embossing Flats on the Cone diametrically Opposite Each Other

Final Punch Press Operations on the Part

The ninth operation is performed by means of the die illustrated in Fig. 11, which forms the part to the shape shown at *I*, Fig. 2. In the preceding drawing operation enough material was left straight at the nose of the part so that it could be squeezed to shape from the outside rather than from the inside. This method was adopted because of the trouble which results from the other method of drawing; the piece invariably ruptures at the point and is entirely unsatisfactory. It will be seen that this die holds the part in a horizontal position. The punch-holder and base of the die are made of cast iron, while the remaining parts with which the work comes in contact are made of tool steel.

The work is placed over the tool-steel piece *A*, which is shaped like a cone and acts as the plug in a die of standard construction. A 1-inch cold-rolled bar attached to the plug serves as a handle, by means of which the operator places the plug and work in the lower half of the die. The plug is prevented from being forced from the die as the punch comes in contact with the work, by means of two lugs *B*. In this operation, as the upper half of the die descends with the ram, it presses the work on the plug. Four strokes of the press are required to complete the operation, the plug being given a quarter-turn after each stroke. A slight jar against the side of the part is sufficient to loosen it from the plug in order to effect its removal.

The tenth operation embosses two flats on opposite sides of the cone, as shown in Fig. 2 at *J*, the die employed for this purpose being illustrated in Fig. 12. As in the preceding operation, the part is held in a horizontal position on a tool-steel plug *A*. The punch-holder and die in this case also are made of cast iron, while the parts which come in contact with the work are made of tool steel. The handle of the plug is a cold-rolled 1¾-inch square steel bar. In addition to its use in placing work in the die, the handle provides a gage for insuring that the plug will be so placed in the die that the embosses will be made directly on the axis of the work. Both embosses are made at one stroke of the press, parts *B* and *C* of the punch and die, respectively, being similar. The part is easily removed from plug *A* by jarring it slightly against the bolster plate of the press.

The final punch-press operation on the part strikes and packs the base as shown at *K*, Fig. 2, this shape being identical to that shown at *J*. The operation is performed to smooth out any wrinkles that may be left by the previous reductions, and brings the piece to the exact desired size. The die used is shown in Fig. 13. The base and punch-holder are made of cast iron, while the parts which come in contact with the work are made of tool steel, as in some of the dies previously described. This makes a construction which is, in general, equal to an all-steel die, and has the advantage that the material and labor costs are less.

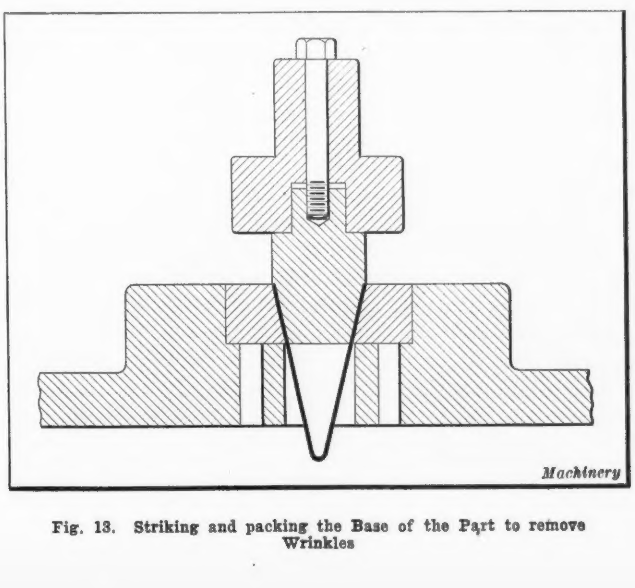


Fig. 13. Striking and packing the Base of the Part to remove Wrinkles

An idea of the accuracy required in the parts produced by the dies here described, can be readily obtained by reference to the gage illustrated in Fig. 14, upon which the parts were inspected. A line is scribed 0.011 inch from the base, and it was necessary for the end of the part, when the latter was slipped over the gage, to come between this line and the base. The parts were so consistently accurate that only a few failed to pass inspection. All the dies described in this article were designed and manufactured by the Acklin Stamping Co., Toledo, Ohio.

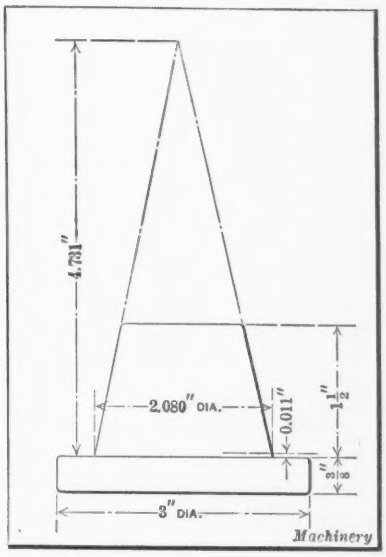


Fig. 14. Gage for inspecting Conical Shells

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FOREIGN TRADE NOTES

Reports from Belgium indicate an industrial depression particularly affecting the textile industries; but the present foreign trade of Belgium exceeds that of 1913, even when the depression of the franc is taken into consideration.

In France the question of fuel is of prime importance. It has now been agreed that Germany will supply the allied countries with 2,000,000 tons of coal a month beginning February 1. France will receive 65 per cent of this total. Oil fields have recently been discovered in Lorraine which doubtless will prove important to the French industries. It is reported that at the end of last year 50 per cent of the steel works destroyed or damaged during the war, 67 per cent of the textile factories, 50 per cent of the glassware factories, and 54 per cent of the chemical industrial plants were in operation.

In Italy, apart from labor troubles, the most serious difficulty is the question of fuel. Various plans have been proposed to relieve the shortage of coal, but whether any of these will prove successful remains yet to be seen.

The German competition in the world's markets is beginning to make itself felt. It is reported that trade between Germany and India, China, and South America is increasing. Various reports indicate that the most severe financial and industrial crisis in Germany has passed, and that the country is rapidly returning to its former producing capacity. The difficulty of Germany is largely the same as of the other European countries—a shortage of coal.

In spite of the financial depression in Japan there is great industrial activity, and plans for the extension of manufacturing in various lines are made. It is generally believed that the exportation of machinery of different classes to Japan and China will greatly increase during the next five years.

The South American requirements for industrial machinery—particularly in Brazil—are quite important, but the machine tool requirements are comparatively small. The reason for this is that the industries being developed in Brazil are mainly sugar and distilling plants, mining, electric lighting plants, etc. On the other hand, there is very little manufacturing in Brazil for which machine tools are used, and, generally speaking, the main uses for machine tools are in the railway repair shops and in the repair shops of the various industrial establishments. The same holds true largely of the other South American countries.

The Service Department and the Superannuated Machine Tool

By GEORGE M. MEYNCKE, The Oesterlein Machine Co., Cincinnati, Ohio

As everyone who will read this article is familiar with the fundamental facts about automobiles, I will give the sense of a letter recently received in terms relating to automobiles, assuming that motor cars had been in use for the past fifty years or so. Then assume that the Gogood Automobile Co. received the following letter today:

"Gentlemen: The Gogood automobile that my father purchased from you in 1884 recently met with an accident. Please send me list of parts or illustrations of that model so that I can order the necessary repair parts."

That sounds overdrawn, doesn't it? But a similar letter addressed to a machine tool builder is not unusual, if the manufacturer happens to have been in business for that length of time. One of those letters was received early this year by The Oesterlein Machine Co. It read as follows:

"Gentlemen: Several years ago we purchased with some other machinery a small drill press from Oesterlein & Bernhardt. We are in need of some broken parts for the press, and failing to find such a named concern listed now, we are wondering if your company is successor to Oesterlein & Bernhardt. We are anxious for this information and shall deem it a special favor to hear from you regarding this matter."

Referring as this letter does to a drill press built by Oesterlein & Bernhardt, it is doubtful if anybody now living can tell how long ago that machine was built. The great Ohio River flood in 1884 wiped out the shop of Oesterlein & Bernhardt, and when the water receded, all that was left was the partnership, which was dissolved by the withdrawal of Mr. Bernhardt.

One of the many products of Oesterlein & Bernhardt was drill presses. That flood was thirty-seven years ago, and the drill press described in the letter as purchased "several years ago" probably was built some years before the flood (the Ohio's—not Noah's.) It is forty or more years old today and is, according to the letter, only "in need of some broken parts" to put it back on the job.

Long Life of Machine Tools Presents a Service Problem to the Builder

It has often been said that the trouble with the machine tool business is that machine tools last too long, which in more specific terms means that the builders do not charge enough for their product in the first place. Suppose the owner of this drill press paid $400 for it forty years ago. The actual depreciation on that tool has been at the rate of twenty cents per week. What class of products, other than machine tools, can show such a low depreciation rate?

It undoubtedly would not pay to keep such an old style machine in service in a production shop. Nevertheless, there are shops in which such old tools meet the requirements, and they should, and will, be used; and they will be passed on until they find the strata of application to which their ability responds.

The long life of machine tools gives rise to a problem that is almost exclusively a machine tool problem. It is the repair problem. Machine tool design and construction does not stand still. Its history shows change after change in every type of tool. A problem incident to any change in machine tool design is the preserving of superseded drawings, patterns, and jigs, so that service on repairs and attachments may be given throughout the life of the tool.

The maker feels an obligation at all times to be in a position to give this service, and usually does give it at slight or no profit to himself. In fact, if the cost of upkeep and storage on old drawings, patterns, jigs, and tools was included in the repair parts cost, it is doubtful if a machine tool repair order is ever anything but a losing transaction. Contrast this with those industries whose product has short life and is produced in large quantity. In such cases, repair parts can be converted into an item of considerable income and profit to the maker.

Dividends on Service Investment

The ability to give good service on machine tools fifteen to twenty years old is not general in the industry. It has taken years to demonstrate that more care must be given to this phase of the work. Judging from the attention that this is receiving today by machine tool builders in general, it is safe to predict that in an equal period of years from today, good service, from accurate records, will be the rule.

It is not uncommon to hear such remarks as "When old man White ran the White Tool Co., he had only two clerks to help him, and now there are eight men doing the same work." Those on the inside realize that old man White neglected to do many things that for the sake of better business are necessary today. One of the items of overhead that is put into the shop system of today is the record insurance that will yield service dividends in the future.

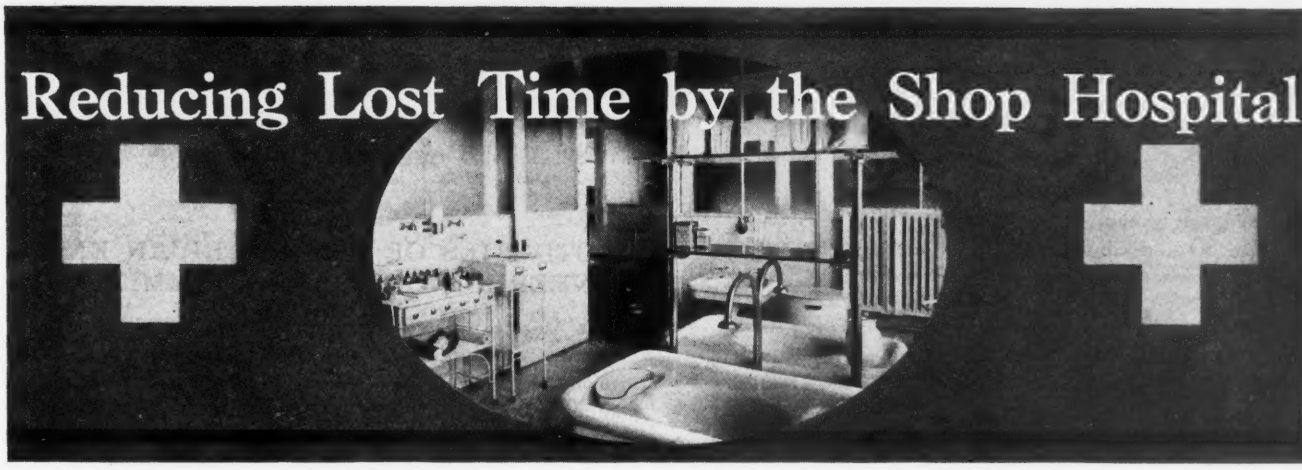
* * *

PRESENT ACTIVITY OF THE KRUPP WORKS

In spite of the great industrial difficulties that German industries have passed through during the last two years, the Krupp Works in Essen still maintain their place as one of the largest industrial undertakings in the world. Last year the works employed on an average of 93,000 people, of which 50,000 were employed at the works in Essen and the remainder at the various iron works, and coal and ore mines controlled by the Krupp Works, as well as at the Germania Shipbuilding Yards in Kiel. In 1914 the total number of employes was about 80,000. During the war a larger number was employed, amounting in 1918 to 172,000.

Before the war the works were known almost exclusively as the producers of war material, although in point of tonnage, war material formed but a small percentage of their output. Before the war these works supplied from one-fifth to one-third of Germany's total requirements of railroad materials, including rails, wheels, and wheel rims, boiler plate, axles, and springs. During the war the Essen Works were enlarged so that the surface covered by buildings increased from 248 to 392 acres. After the armistice the works were turned into repair plants for locomotives and cars, and one part of the works has been permanently turned into a plant for the production of locomotives and rolling stock, capable of producing 300 heavy type locomotives with tenders annually, and 2500 cars. Other branches of the works are now engaged in the manufacture of motor trucks, agricultural machinery, textile and paper machinery, internal combustion engines, turbines, adding machines, cash registers, and many other products.

Reducing Lost Time by the Shop Hospital



By SANFORD DeHART, Director of Hospital, R. K. LeBlond Machine Tool Company, Cincinnati, Ohio

WHEN visitors come to our plant and pass through our hospital, they invariably inquire, "How well is your hospital patronized?" When we tell them that we are treating, on an average, seventy patients a day they are amazed. Many people are of the opinion that an industrial hospital takes care of major surgical conditions only. This is an erroneous assumption as the following will serve to prove. During the year 1920, there were treated in our hospital department 20,625 patients. This is a grand total in which the report of our dental department is included. This report includes surgical, medical, and dental cases, and retreatments.

Functions of Industrial Hospital

While it is true that the primary function of an industrial hospital is to take care of injuries arising out of a man's employment, the line of demarcation is not so clearly defined as it once was with reference to extraneous conditions. As a matter of fact, there is a greater loss of time due to illness than from surgical conditions. We have found that if we can reach the sick employe in the incipient stage, and if he is not suffering from an abnormal temperature, we can usually prevent the condition from becoming serious.

The successful hospital director of an industrial plant must be constantly on the alert for equipment, medicines and appliances, which can be used in industry for the reduction of absenteeism. He must be a modernist without being an extremist. To illustrate: We were having, as every other factory has, a high absence rate due to employes losing time on account of colds. We had proceeded along the usual lines, treating these cases as the average physician would treat such conditions outside the factory. However, it did not take us long to ascertain that the methods pursued outside were not effective in our factory, so far as reducing absenteeism was concerned. To increase our efficiency in the treatment of these conditions, we installed a spraying outfit, which works on the same principle as an atomizer, with certain improvements, such as an electric attachment, compressed air outfit, etc. This spraying outfit is known technically as a "nebulizer," and is similar to the equipment used by nose and throat specialists.

There is something about treatment with mechanical devices that makes a man feel as though something is being done for him. The patient experiences an agreeable sensation in the mouth, throat, and nasal passages and is usually willing to go on working. This outfit has reduced our absences due to colds about 37 per cent.

Likewise anyone who has ever tried to work while suffering from a stiff neck knows the pain one has to suffer. The concentration of electric heat rays, by properly constructed lamps, is an inexpensive apparatus we have used with a great deal of success in these cases. Relief is generally obtained in about twenty minutes. It is necessary, however, to repeat the treatment twice during the day. In this connection, it is well to know that stiff necks and lame backs often occur in epidemic form. These are two illustrations that show the distinct advantage over the old method of routine treatment.

A distinguished physician of Boston, Mass., once made the statement that most patients would get well, even if there were no treatment administered. A man with a stiff neck or a sprained back no doubt would get well, but industry would be deprived of his services while he was recovering. By assisting nature, recovery is often expedited.

By persistent education, largely through billboard propaganda and a factory magazine, we have reduced the accident frequency and severity rates considerably. Our 1920 records show that there were 192 less days lost than in the previous year. The injuries received for the most part were abrasions or scratches. While these conditions are minor, they become dangerous if infection sets in. Insurance companies state that they pay out more money for this type of injury than for the major injuries, since small wounds are prone to infection.

There were 1417 eye conditions treated during 1920. These cases were treated in our own eye room, which is a dark room especially equipped with electric magnets, local anaesthetics, and medicines for the eye. The particles in the eyes for the most part were floating and easily removed. Where the particle, such as emery or steel, had struck the eye ball with any force, or where it had been in the eye over night, it caused the most trouble. These pieces occasionally became adherent to the eye ball and often embedded in the eye, necessitating removal with the aid of a local anaesthetic. The subsequent treatment of these cases consisted of dilatation, a shield placed over the eye, and treatment every two hours, the patient remaining at work.

Results Obtained by the Shop Hospital

Our eye cases show a gratifying decrease. During 1917, the policy was to refer all eye cases of more than ordinary severity to an eye specialist, whose office was situated some eight miles from the plant. During 1917, 861 hours were lost, or 107 working days, from this one cause alone, at a cost of $1052. This amount included specialist's fees and state compensation, but did not include the amount lost in production.

In May, 1918, our eye room was established, and we were able to reduce our lost time due to eye injuries to 436 hours at a cost of $412. During 1919 we further reduced our lost time from eye injuries to 78 hours at a cost of $26. During the past year there were 80 hours lost, but the direct cost was only $7.50. This was accomplished without any change or addition to the hospital personnel. Impressing the em-

ploye with the importance of wearing goggles, and removing the foreign body from the eye before it becomes too firmly embedded, with the subsequent treatments, was largely responsible for the reduction. There were no eyes lost, and no impairment to vision during the year.

Reducing Accidents by the Aid of the Shop Hospital

There are a number of different causes that might contribute to the accident problem. They may be mechanical, physiological, or psychological. We have minimized the mechanical causes by installing safety devices, and where safety devices are impracticable, warning signs of danger are conspicuously placed. The psychological causes of an accident are carelessness, ignorance, over-familiarity with the hazards of employment, unfamiliarity with the employment hazards, lack of confidence, lack of discipline, and the susceptibility of the individual to accidents. Accidents do not always happen as the result of objective danger. Individual characteristics of the employe have much to do with accidents. The human factor is the chief consideration in 80 per cent of the accidents. The psychological and physiological causes of accidents are of the highest importance. The physiological causes may be due to mental worry, sleepless nights, toothache, and various diseases. One can very well understand, for example, how a toothache might be indirectly responsible for an accident.

The writer has purposely avoided mentioning fatigue, owing to its complexity. The measurement of the condition of industrial fatigue in a machine tool plant, judged by the capacity of a workman for turning out work, is a poor index as to the amount of fatigue present.

To prevent accidents due to the nervous condition caused by toothache, the R. K. Le Blond Machine Tool Co. established a dental department which has been in operation for two years. The dental department is a subsidiary department of the hospital. An idea of the popularity of this department may be gained from the fact that there were 1716 cases treated during 1920. They are classified as follows: Examinations, 244; extractions, 271; prophylactic, 240; X-ray, 10; toothache, 158; fillings (temporary), 57; treatments, 687; and pyorrhea, 49.

The saving to the company on extractions for the year 1920, based on the time a man would ordinarily lose if he were to visit his family dentist during working hours for the relief of toothache, is conservatively estimated at approximately $1200. It has often happened that an employe reporting for work after a sleepless night, due to an ulcerated tooth, was willing to continue work after being relieved by our dentist. If we had not been situated so that we could relieve these conditions, we would have lost the services of the man for the entire day.

Summary of Hospital Report

An idea of the work accomplished for the year in the Le Blond shop hospital can best be illustrated by the following figures, taken from our annual report, giving the number of cases treated: Surgical conditions, 6198; redressings, 4163; medical conditions, 5473; retreatments, 3075; and dental conditions, 1716.

We have greatly minimized the accident frequency rate among the apprentices by giving them talks on safety during school hours. These talks are accompanied by lantern slides, moving pictures, and pictorial bulletins. We have received excellent cooperation both from the instructor of the apprentice school and the foreman of the shop training school. They have been intensely interested in preventing accidents to the apprentices. The fingers are the most exposed part of the body. It used to be that an amputated finger was the badge of a machinist's trade. So well have the machines been guarded and so prompt and efficient the treatment of injuries, that we have had occasion to amputate but one joint of one finger in the last three years. It is hardly possible to overstate the importance of prompt and efficient first-aid to shorten and minimize the effect of accidents. We have had occasion to send one man to the city hospital in five years, and we have only found it necessary to use our own operating room twice in three years. This is truly a remarkable record for a plant employing about one thousand men.

* * *

ACTIVITIES OF THE AMERICAN ENGINEERING STANDARDS COMMITTEE

The American Engineering Standards Committee is working in close cooperation with the foreign national standardization bodies, and copies of the following engineering standards issued in 1920 by these foreign standardization commissions are on file at the headquarters of the American Engineering Standards Committee. Those engineering standards that are of interest to the metal-working and machine-building field in general are listed below:

British Engineering Standards

No. 1. Rolled Steel Sections for Structural Purposes
No. 100. Body Spaces and Frame Ends for Chassis for Private Automobiles
No. 122. Milling Cutters and Reamers
No. 131. Notched Bar Test Pieces

Canadian Engineering Standards

No. 1. Steel Railway Bridges

Belgian Engineering Standards

No. 1. Construction of Metal Framework
No. 2. Construction of Metal Tanks
No. 3. Construction of Coverings and Partitions of Corrugated Galvanized Sheet Iron
No. 4. Shafts and Transmission Pulleys
No. 5. Construction of Metal Bridges

Dutch Engineering Standards

N-19. Compression Couplings
N-20. Flange Couplings
N-29. Loose Collars for General Construction
N-30. Loose Collars for Mill Gearing

German Engineering Standards

DIN-187. Bearings for Transmission Shafting
DIN-475. Widths of Spanner Jaws

Swiss Engineering Standards

VSM-10300 to VSM-10307 Technical Drawings
VSM-12050 Screw-Whitworth Threads
VSM-33900 to VSM-33914 "Sulzer" Attachment for Milling Cutters

Swedish Engineering Standards

SMS-1. Size for Standard Sheet
SMS-2. Metric Screw Thread System
SMS-3. Whitworth Screw Thread System
SMS-5. Hexagonal Nuts
SMS-7. Finished Hexagonal Screws
SMS-8. Series of Standard Diameters

Photostatic copies of these standards can be furnished at a nominal cost, or the copies on file may be consulted at the offices of the American Engineering Standards Committee, 29 W. 39th St., New York City.

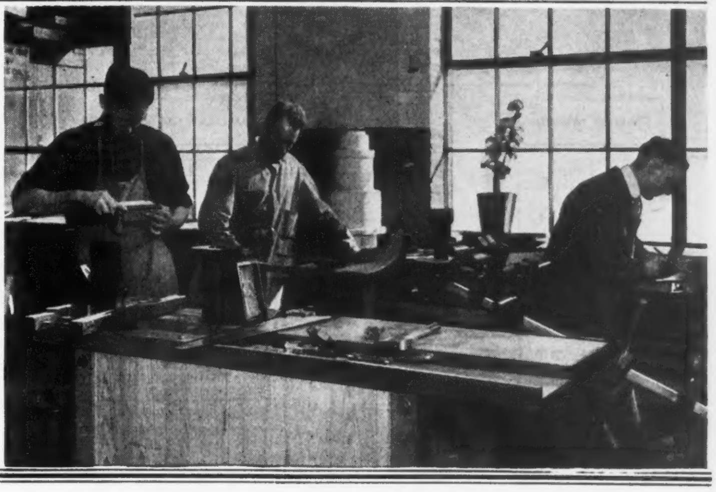
* * *

It is reported that the Cunard Co. will build twenty-three new steamers having a total tonnage of over 300,000, which will give this company control over more than 1,000,000 tons of shipping. The present plans are for smaller and speedier steamers than have generally been built in the past. Six of the new steamers will be of 15,000 tons.

Training Men for the Machine Industry

A Description of the Highly Organized Educational and Training Departments Established by the Norton Co., Worcester, Mass., with a View to Qualifying Men for Various Classes of Occupations in the Machine Industry

By ERIK OBERG



WITH the development of the industries it has been found that the educational institutions of the country supply only part of the needs of the industries for trained men. The engineering schools and colleges train engineers, and trade schools provide educational facilities for a limited number of boys planning to take shop positions; but there is neither a sufficient number of these trade schools, nor are all of these schools so organized as to educate and train the boys passing through them in the best manner for the needs in manufacturing plants.

It has therefore become necessary for the industries—and particularly the machine building industry—to establish, through their own initiative, courses of training in individual shops and plants, whereby men may obtain the instruction necessary to fit the particular needs of a specific industry. Some of the large electrical companies have long maintained training schools of one type or another for this purpose. In the machine tool field, few manufacturers have plants large enough to warrant the establishment of an elaborate educational department, although many have of late developed well-organized apprenticeship systems with a view to training all-around machinists, toolmakers, and future foremen and superintendents.

Scope of the Norton Educational Department

Doubtless the most elaborate educational department maintained by any manufacturer in the machine tool field is that organized by the Norton Co., Worcester, Mass. The scope of this company's work covers not only the training of machinists and machine operators, but also the training of service men, demonstrators, salesmen of grinding wheels and grinding machines, grain salesmen, office assistants, customers' employes, and agents' salesmen. The various courses provided for these purposes have been described in the December, January, and March numbers of MACHINERY, in the articles by John C. Spence, superintendent of the grinding machine division of the Norton Co. In addition to these courses, however, the company provides a complete mechanical course covering two years, the object of which is to give employes who have not been able to finish high school an opportunity to take up further studies closely related to the practical work in the shop, and to become better fitted to take on added responsibility in the company's organization. Complete courses in office methods and office administration, foremen's courses, educational courses in English for foreign-born employes, and matters relating to citizenship, various evening courses, and extension courses for wheel and machine users and salesmen handling the Norton products are also provided. It is the object of this article to describe briefly the general principles involved in these courses, as it is believed that, as our industries develop, other manufacturers will gradually find it necessary to provide industrial educational facilities, and will therefore be interested in knowing what is being done at the plant of one of the large companies in the field that has developed an educational department of this type. The educational department of this company is under the guidance and supervision of Professor A. D. Butterfield, educational director. Professor Butterfield was formerly connected with the Worcester Polytechnic Institute, but he now devotes his entire attention to the Norton industrial educational activities.

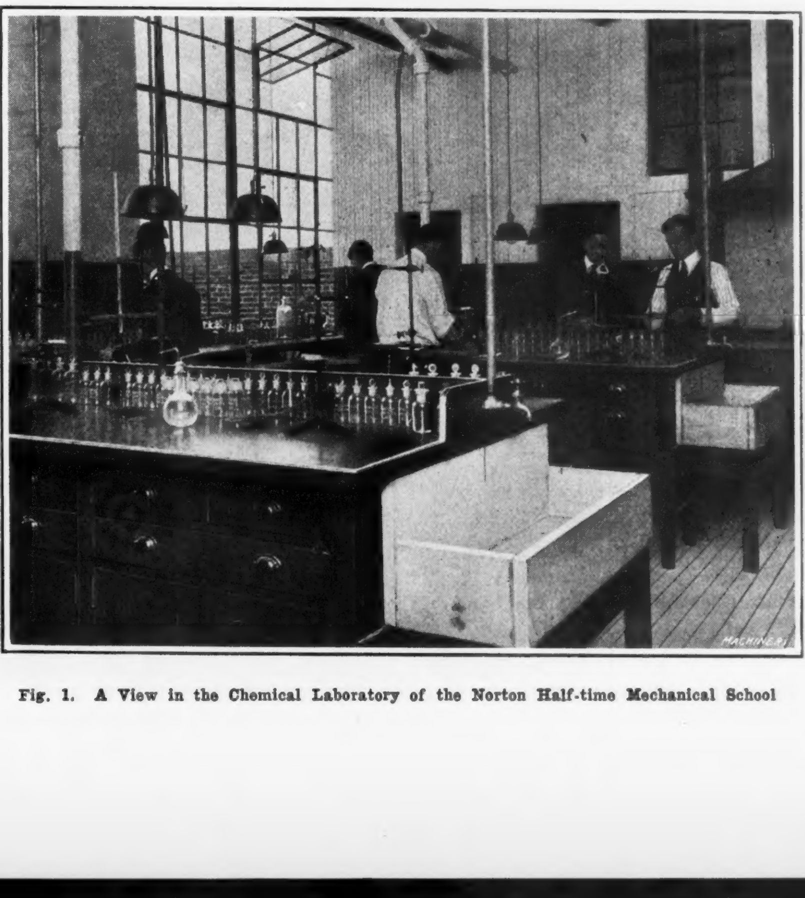


Fig. 1. A View in the Chemical Laboratory of the Norton Half-time Mechanical School

The development of training and edu-

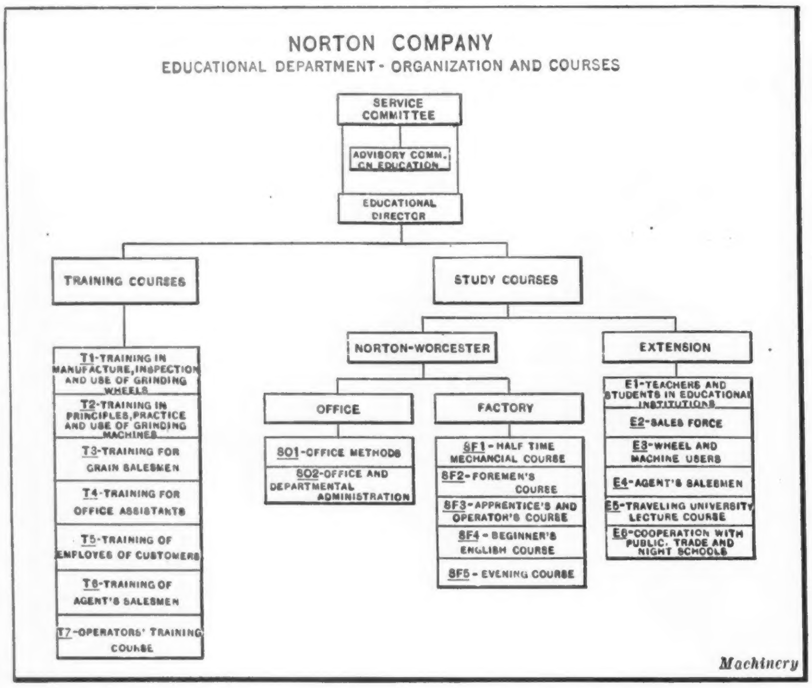


Fig. 2. Diagram showing General Organization of the Educational Department

cational courses as part of an industrial organization is of comparatively recent origin. The first school established by a private corporation in the United States, as far as is known, was that by the R. Hoe Printing Co., of New York City, in 1875. In 1913 the National Association of Corporation Schools was formed, and at that time there were probably not over twenty-five organized schools among the various industries in the United States that provided systematized educational and industrial training. The trend of recent years has been to recognize the great opportunity that industrial corporations have in affording educational opportunities to employes. The war emphasized the need of such facilities, and aided in promoting this movement.

The Norton Co. was among the earlier pioneers in the establishment of training schools. The first course given was in 1912. This consisted principally of a course in shop mathematics, given two periods a week of two hours each to boys in the shop who showed interest and aptitude for additional training. This course was part of the work of teaching the boys the machinist's trade, and was given on the company's time. In 1913 a training course for salesmen was inaugurated, in recognition of the importance of having a sales force trained in the principles of the manufacture and application of grinding wheels and grinding machines. This is the course that was described in the March number of MACHINERY.

In 1914, seven courses of instruction under the direction and supervision of a training supervisor were given for machinists, machine operators, assistants in various departments, grinding machine and grinding wheel service men, demonstrators, and salesmen. The present educational department is a gradual outgrowth of these courses organized in the past, with such additions as time and experience have suggested.

Object and Policy Underlying Industrial Training Courses

The educational department is a branch of the service department of the company, which is defined as a department including all activities, not connected with the actual manufacture of the company's products, that are considered necessary to obtain the best results from the entire organization in the way of loyalty, efficiency, and cooperation. The educational work is based purely on business principles. It is believed that what is of aid and benefit to the individual also benefits the company, because it increases the usefulness of the individual.

The object of the educational work is therefore twofold: First, it affords for such employes as desire and are qualified an opportunity for study, so planned as to fit them for additional responsibility; and second, it provides a better trained and more efficient working force for the company. It has been the policy of the company to develop men from its own organization for the more responsible positions, whenever possible; it will generally be found that there are many men within the organization who need only the opportunity of proper training to bring out their fitness for higher positions.

Organization of Educational Department

Fig. 2 shows a diagram of the general organization of the educational department of the Norton Co. The work is divided into two general groups, known as training courses, and study courses. Each of these sets of courses has a separate supervisor. The entire educational courses are placed in charge of an educational director, who is directly responsible both for the training and the study courses.

Under the head of "training," are grouped those courses that are primarily concerned with the practical side of the industry. In these, emphasis is put upon how to do the work, the training being obtained mainly from actual work in the plant in the manufacture, grading, and use of wheels and in the construction, operation, and care of grinding machines, as already outlined in previous articles in MACHINERY. Under the head of "study" courses are grouped those that follow the usual educational methods of class-room work. These courses may be considered as covering the scientific side of the industry and as having to do with the "why" of things. The study courses are subdivided

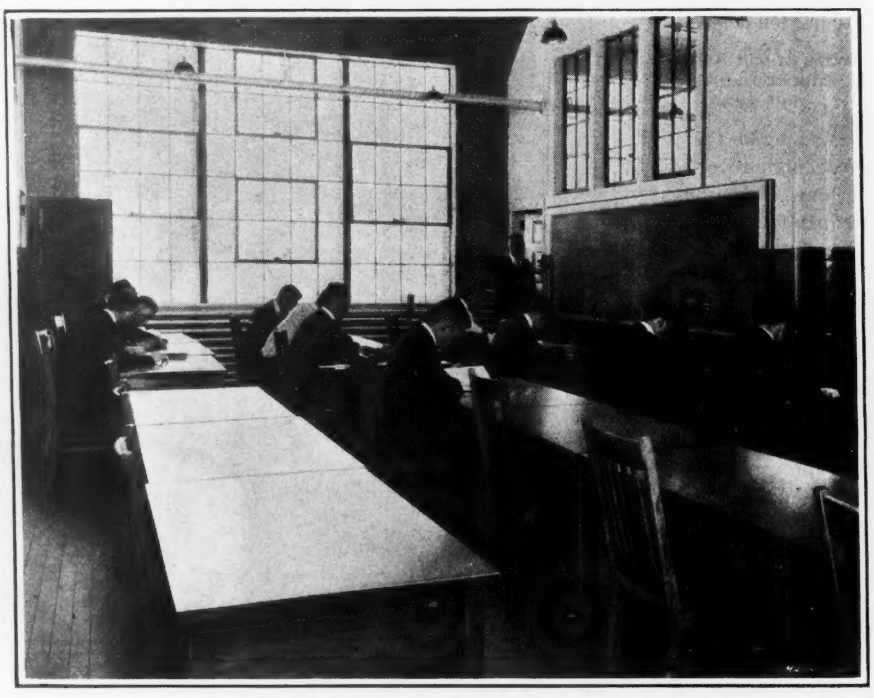


Fig. 3. A Class-room in the Half-time Mechanical School

into two sections—those given in the class-rooms, office, or factories at the Norton plant in Worcester, and those given elsewhere by correspondence or extension work.

The Half-time Mechanical Course

As previous articles have dealt with the training courses, the present article will deal mainly with the half-time mechanical course given by this company. This course covers two years and is arranged on a half-time basis; that is, the men work two weeks in the class-room and two weeks in the shop, alternately, during nine months of the year, while during the three summer months they alternate between their regular machine shop work and work in the foundry and pattern shop. Fig. 4 shows a floor plan of the class-rooms and laboratories. At the present time there are about fifty students in this course, all of whom have had either a complete or partial high-school education, and some of whom have had one or more years of college. The course is really an intensified engineering course, specialized for the needs of the machine building and the grinding wheel industries. The class-room work is arranged on an eight-hour basis with four hours on Saturday, and all the class-room work is done under personal supervision. In addition to the educational director, three instructors give their entire time to the class-room work, and half a dozen specialists give part of their time to special subjects in the class-room.

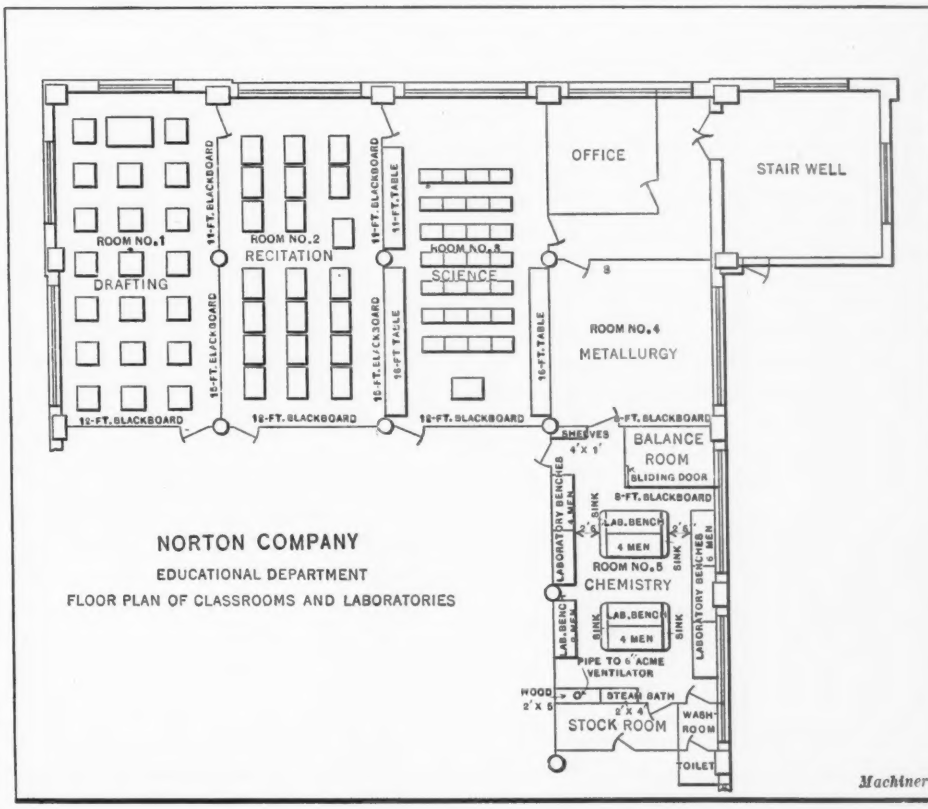


Fig. 4. Floor Plan of the Class-room and Laboratories used for the Half-time Mechanical Course

At least two years of high-school work or its equivalent is required for entrance in the course, as well as a knowledge of shop work equivalent to that which can be expected from one year's work in a shop. An oral and a written examination of the candidates test their ability to express themselves clearly on the subjects in which they are being examined. Each of the students who is enrolled in the course receives individually such a wage as is mutually agreed upon by the company and the student for the time that he works in the shop. It is expected that students who enter this course will do so with the intention of completing the two years' work, and that they will remain with the company a reasonable length of time after having completed the course.

Outline of the Course

Briefly stated, the course includes shop arithmetic, algebra, plane and solid geometry, trigonometry, with practical problems from machine shop work, elementary mechanics, study of mechanisms, free-hand drawing, mechanical drawing, design of machine parts, and machine design, materials of construction, tests of materials, practical electricity, pattern shop practice, foundry shop practice, forge shop practice, time study, shop management, and fundamental principles of economics and their application to practical industrial problems.

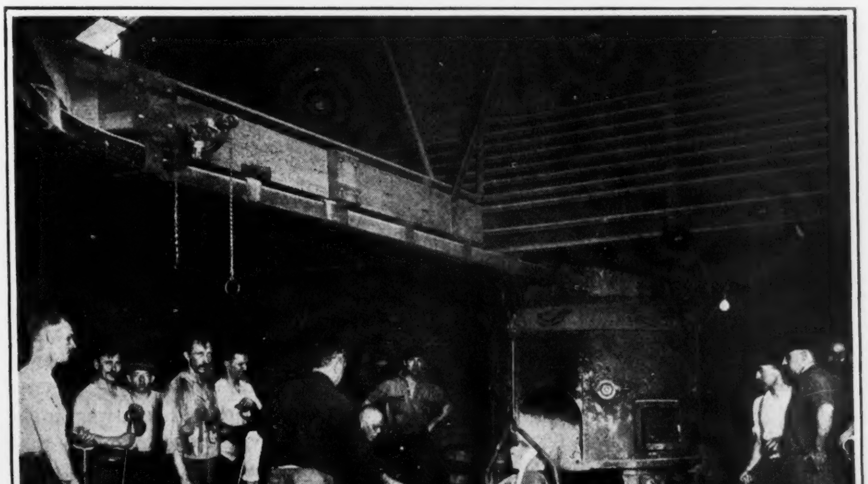


Fig. 5. During the Summer Months the Students of the Half-time Course receive Training in Foundry Work

Foremen's Course

The foremen's course is intended to acquaint foremen and sub-foremen with the relation of their department to other departments, and with the reasons for the systems used. It may be termed a "correspondence lecture" course, and consists of a weekly written article, followed by a weekly conference hour, at which time the subject matter of the lecture is discussed and questions answered or problems given. The conference hour is on the company's time. The course covers the following subjects: Discipline, wage

systems, inspection, spoiled work, tool systems, planning systems, stock systems, care of machinery, service department, safety, health, and sanitation.

Other Courses Provided

In addition to the courses outlined, a course for apprentices and operators is provided, entirely apart from the regular training courses, whereby the operators may obtain through a weekly written lecture, arranged on the same plan as the foreman's course, instruction in shop arithmetic, blueprint reading, elementary mechanics, etc. Written reports and examinations are given to test the student's knowledge. One two-hour weekly lesson is given for explanations and individual instruction—one hour being taken on the company's time, and the other hour, on the student's time.

The evening courses arranged for meeting the needs of employes who cannot afford the time or expense to take

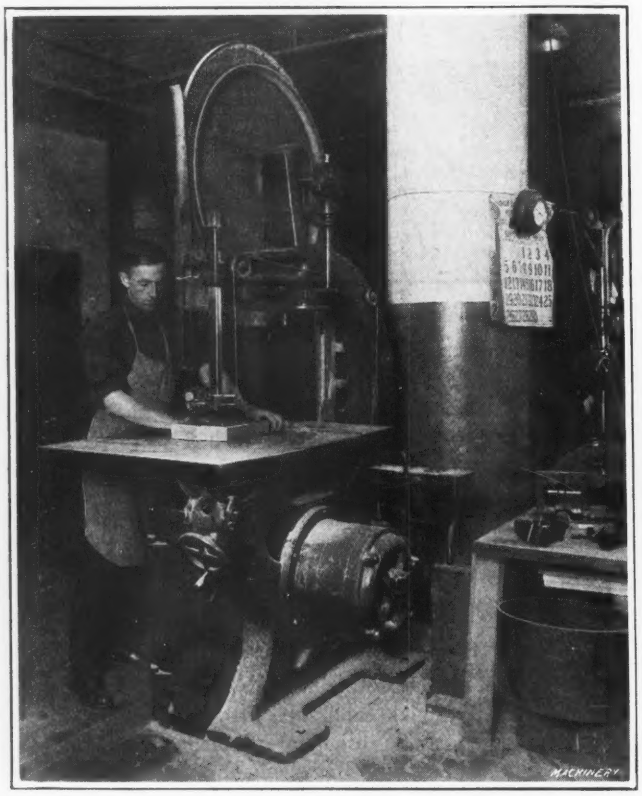


Fig. 6. Patternmaking is also taught the Students during the Summer Months

any of the other courses, cover elementary and advanced mathematics, free-hand and mechanical drawing, machine design, and French and Spanish. These evening classes are given three evenings a week from 5.30 to 8.

A carefully planned course is also given to foreign-born non-English speaking workmen, to afford them an opportunity to learn to speak, read, and write English, and to make them acquainted with American ideals, history, customs, and methods of government. This course is given one hour per week on the company's time.

Some of the courses outlined are of recent origin, and the actual results obtained cannot yet be recorded. Other courses, again, have been given for several years, and the results have in every instance been equal to the expectations. The Norton Co. ascribes a large percentage of the efficiency achieved during the war in its manufacturing department to its training courses, and it is evident that by the methods outlined it is possible to create and maintain a working force superior to one in which the men are expected to depend entirely upon their own resources in fitting themselves for performing the work upon which they are engaged with the greatest efficiency.

SHOP TRUCKING ON A BONUS BASIS

By ROBERT J. SPENCE
Supervisor of Training, Norton Co., Worcester, Mass.

The ways of shop truckmen are strange, and shop trucking has more possibilities toward opening up an interesting study than would appear on the surface. One day some years ago the writer met a big, husky truckman carefully pushing a truck on which balanced a piece of work about the size and shape of a baseball. "Jim," asked I, out of mere curiosity at the strange sight, "where are you going with that piece of work?"

"Up to the third floor," said he.

"Why don't you leave the truck behind and carry the work in your hand up the stairs instead of pushing the heavy truck and having to wait for the elevator? Have you a load at the end of the journey that you intend to bring back."

"No," said he, "but whenever I leave my truck behind someone borrows it and it takes me longer to find it than it takes me to do what I'm doing."

Such logic as this from Jim's point of view was unassailable; the simple expedient of a chain and padlock was far beyond his vision, and even if he had thought of it, why bother with such things when they get lost anyway?

Shop trucking, in time, becomes an institution. The job is a peculiar one from which the more ambitious graduate, and to which the less ambitious gravitate. The perfect balance between too much ambition and too little ambition is so delicate that when once a paragon is found with such perfect balance, the proper procedure is to hang on to him. The advent of the electric shop truck complicated matters a trifle. The truckman was elevated to the dignity of chief engineer of the new truck, and he was given a helper. Such a new dignity called for a watchful guardianship of the new piece of apparatus, while the helper went through the manual performance of loading and unloading the truck. The consequent result was an inability to hold the helper.

Some time ago the machine division of the Norton Co. was confronted with the fact that it must either buy additional electric trucks or induce the truckmen to do more work. There were five electric transportation trucks in service in the shop, and it looked as if two new ones would have to be purchased for the additional demands on the trucks, and possibly a spare truck for emergencies and substitution during repairs to the other trucks. A survey of the situation revealed the facts that the five trucks made 375 calls per day of 10 hours, or an average of 75 calls per truck. The calls ranged from a casting of a few ounces to castings of two tons. Each order was considered a call.

In rearranging the system of compensation, with a view to obtaining better results from the trucking division, it was decided that 80 calls per truck per day of 10 hours was an equitable figure to use as a base from which to calculate. It was decided to pay each truckman a day's pay for the first 80 calls in a 10-hour day. The decision was also made to pay a bonus of three cents per call to the driver and three cents to the helper, on all surplus calls over 80 in a 10-hour day. For a 9-hour day instead of 10, the ruling was made that the bonus was to start after 72 calls; for 11 hours, the bonus was to start after 88 calls. The regular shop day of 9 hours with time and a half for each additional hour was to be figured as a wage, and there was to be no stipulation that the truckman should make a minimum number of calls per day in order to receive his regular day's wage.

How the Piece Rate Brought Results

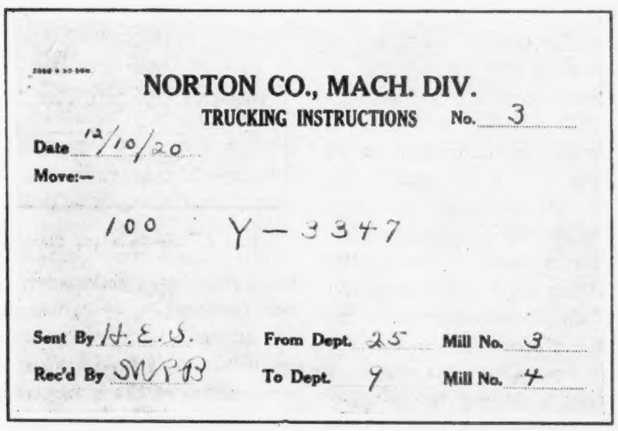
This arrangement could not help but appeal to the truckmen. There was nothing for them to lose and everything to gain. They were guaranteed their day's wage, regardless of the number of calls made per day, and there was a possibility of an added wage in the form of a bonus for extra endeavor. They went at the thing with a zest. Results and returns from the scheme became apparent from the start.

After being in operation for six months, the returns showed that the daily calls never dropped below 130, and at times went as high as 180. Each man on a truck, both driver and helper, makes from $5 to $12 per week as a bonus over his week's wage by this plan. Friction between the driver and helper is eliminated, because the driver assists the helper to load and unload the truck. Larger loads are taken per trip because of a systematized study in the piling of work on the truck. Calls that formerly took several trips are thereby taken in one load at the price of one call.

The labor cost that formerly was between 14 and 15 cents per call has been reduced to an average of about 11 cents per call, and the average time for each call per truck has been reduced from 7½ to approximately 4 1/3 minutes. Foremen and others have gotten over the instinctive tendency to send workmen on errands to other departments, because the fast service makes the cheapness of a 4 1/3-minute trip incomparable with the usual foot-service. The same number of calls that were formerly handled by five trucks are now handled by three, and the two trucks that were released by the new arrangement are being held in reserve.

The System of Handling Calls

The system of handling the calls is very simple. When a foreman has material to move he telephones to the maintenance department. This department occupies a central station convenient to all divisions of the shop. The call is handled by a girl, who has this assignment as a portion of her work. She makes out a slip in duplicate, showing the part number, the number of pieces, the department making the call, and the destination of the work. The truckman must go to the central station to receive the slips and any necessary instructions. He is given quite a number of slips on each trip so as to save all the time possible. The truckman must pick up the material wherever it is placed, or piled, and must place the incoming delivery wherever the foreman designates. He must get the foreman's, or assistant foreman's, initials on the slip from both places. After the truckman has completed the calls he turns his slips back to the girl, and this makes the basis on which to figure his pay. All slips must be turned in the same day they are received.


NORTON CO., MACH. DIV.
TRUCKING INSTRUCTIONS No. 3
Date 12/10/20
Move:—
100 Y-3347
Sent By H.E.S. From Dept. 25 Mill No. 3
Rec'd By SWPB To Dept. 9 Mill No. 4

Form issued to Truckmen, containing Necessary Information for the Transportation of Material

When a call is received over the telephone, or otherwise, the girl in the central station immediately makes out the instruction slip and registers on the reverse side, with a recording stamp watch, the hour and the minute of the arrival of the call. When the slip is returned by the truckman and the initials of the sending and receiving foremen show that the call has been completed, the time of the arrival of the slip is also stamped, after which it is filed away for evidence later as a possible tracer. Slips of different color are used to indicate the urgency of a call. A blue slip is the most important of all, indicating an emergency, and such calls must be attended to without delay. A red slip comes next in importance, requiring that the material must be delivered promptly. A white slip is used for the ordinary shop call. The form used is shown in the accompanying illustration. A red slip or a white slip can become an emergency call by stamping in large letters the word "Emergency" on the face of the slip, and a white slip can assume the importance of a red slip by placing on it a "Rush" stamp.

By the use of these different colored slips, the truckmen know at a glance, when they receive several call-slips, which calls to attend to first, so that valuable time is saved which might otherwise be spent in reading through each instruction call-slip if they were all of one color. If all the truckmen are out in the factory when an emergency call is received by the central station, the girl immediately turns a button which throws on a red light that is visible from several points in the shop. On seeing this light, a truckman returns at once to the station. A green light below the red light indicates that two such calls have been received or that two trucks are needed, and two truckmen respond.

The work is simplified for the truckman somewhat because there are certain well-defined traffic lanes which are kept clear at all times. These lanes are defined by thin sheet-steel strips about two inches wide, securely nailed to the floor throughout the entire plant. No material is ever allowed to be placed in a position to obstruct these traffic zones.

Handling Finished Work

Work that has been completed and is in a finished state ready for the stores department is usually handled by one man who has demonstrated that he appreciates fully the value of taking care in handling finished material. The same man also delivers these finished pieces to the assembly hands from the stores. This places the responsibility for any damage in transit directly on the shoulders of one person, and the blame is properly fixed without recourse to the files. For all such finished material, a yellow slip is used, and the urgency of the call is indicated by the use of a rubber stamp.

System Disciplinary but Equitable

No truckman is at liberty to argue with foremen or assistant foremen over any detail in connection with the trucking of material. All difficulties and complaints are straightened out by the head of the maintenance department in cooperation with the truckmen and the foremen. Friction between the people concerned is unheard of.

This system of handling shop material gives satisfaction all around. The truckmen are happy, because of the opportunity to add to their weekly wage; the foremen are pleased because of the rapid service; and the company is satisfied because of the rapid movement of material, the reduction in cost per call, and the simplicity and lack of confusion of the scheme. Back of the whole plan is the dominant idea that if there is satisfaction among all factors concerned in any distinct group (services honorably requested and honorable services rendered) there is bred a harmony that blends into a spirit of cooperation among all groups, and there need be no worry as to the morale of the organization.

* * *

RESUMPTION OF BELGIAN INDUSTRY

Statistics prepared by the Belgian Government indicate that the Belgian mining industry has fully recovered, and several of the other industries, especially those devoted to chemicals, glass, paper, and transportation, are working to almost full capacity. In June, 1913, the industrial establishments covered in the report employed 651,000 people. In June, 1920, they employed 607,000 people, or 93 per cent of the total working force in 1913. These figures indicate that Belgium is working under practically normal industrial conditions and has virtually recovered from the effects of the war as far as the industries are concerned.

Shell Forming Die

By J. BINGHAM, President, B. J. Stamping Co., Toledo, Ohio

THE die for performing the first operation in making a flange for a radiator filler cap is shown in Fig. 1. This is a combination blanking and forming die. As the steel flange-forming punch *A* descends, carrying with it punch *C*, the blank is punched out and carried down in die ring *B* about 1/8 inch, at which time the punch *C* produces the center hole. As punch *A* continues to descend, the outer flange is formed around die *F* and the center flange is produced by the punch as it passes below the level of the steel insert *G*.

The continued descent of punch *A* depresses the drawing ring *D* until it seats in the die-block as shown in the illustration. Sufficient pressure is thus produced on the rubber buffer, which supports this ring by pins, so that as the punch is raised, the drawing ring will be forced upward and eject the shell from the die. The center slug produced by punch *C* drops through the hole in the center stud. Knock-out *E* prevents the shell from adhering to the punch. The shell is made of 1/8-inch sheet brass; the diameter of the blank is 3 13/16 inches, and its appearance after the first operation may be seen by referring to the detail view shown directly above the punch.

The second-operation die for forming the flange and beveling its outer edge is illustrated in Fig. 2, and the appearance of the work after the completion of this operation is shown directly above the punch. Punch-holder *A* is made of cast iron, and is large enough in diameter to allow the knock-out rods *B* to pass down through the bolster plate, beneath which the knock-out plate *C* is carried. This plate functions as the press ram ascends, at which time the plate comes in contact with the stem of pad *D*, ejects the shell from the die, and supports the pad until the next shell is placed in position. It will be seen that the upper surfaces of this pad are angular so as to form the shell to the correct shape.

The descent of the steel punch *G* forces the previously formed outer flange of the shell around the corner of die ring *E* and up against the shoulder *F*, this being the position occupied by the shell in the illustration. It will be seen that there are a number of coil springs that hold pad *D* up against the pressure of the punch as it descends, and that they are not intended to eject the shell, as the knock-out plate *C* is the more positive provision for this purpose, as previously explained, and holds the stem in its upward position as soon as the ram of the press travels sufficiently to enable it to do so. The shoulder *F* of die ring *E* is a vital part in the construction of the die, as the metal is packed against it so that the edge will be perpendicular to the angle of the formed flange. The punch is also provided with a knock-out *H*, which is of familiar construction and operates in the ordinary manner.

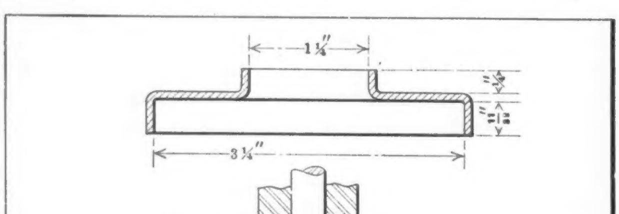


Fig. 1. Blanking and Forming Die used in the First Operation on the Shell

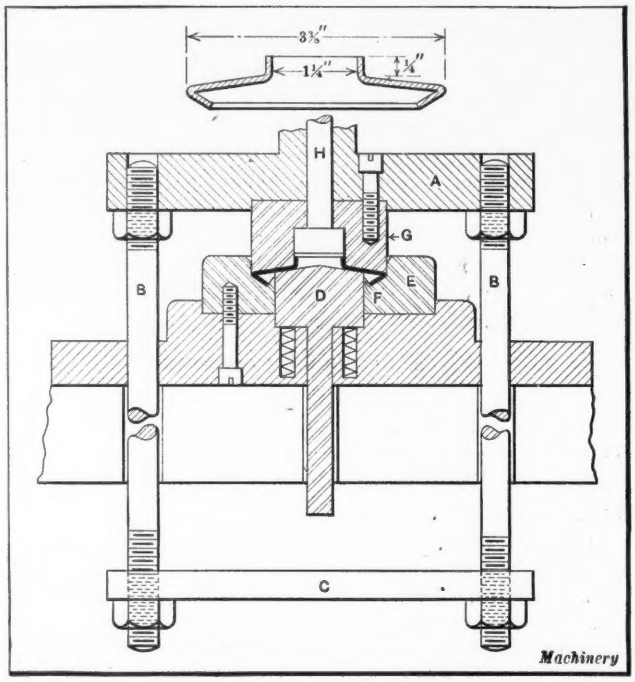


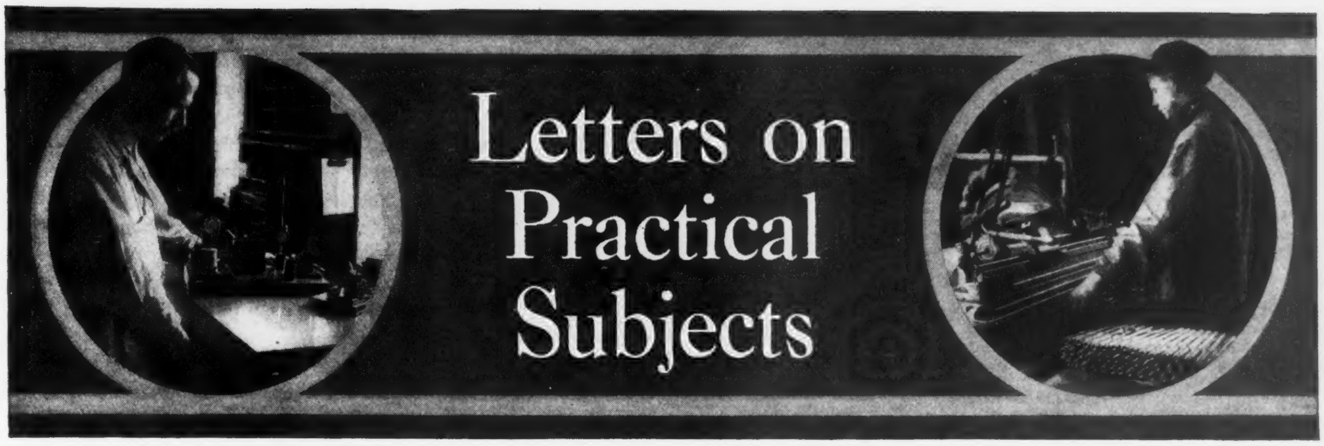
Fig. 2. Die in which Flange is formed and Outer Edge is beveled

* * *

TRADE WITH SPAIN

Previous to the war the principal foreign trade of Spain was with Great Britain, France, the United States, and Germany, in the order mentioned. The imports from the United States, however, did not consist of manufactured products to the same extent as from the other nations mentioned, a large proportion of the exports from this country being represented by raw cotton. During the war the exports from the United States to Spain increased fivefold, while those from France and Great Britain decreased considerably and, of course, the German trade was practically obliterated.

The manufacture of iron and steel is one of the most important of the Spanish industries, the greater part of the domestic production being consumed within the country. Before the war, iron and steel was exported to a value of about $1,000,000 annually, which increased to $7,000,000 in 1916. The depression after the war has been particularly severe in this industry. In spite of recent industrial developments, however, Spain remains to a great extent an agricultural country. The United States furnishes the greater part of the machinery imported by Spain—both agricultural and metal-working machinery. In 1920 Spain imported metal-working machinery from the United States to a value of $1,145,000, and in 1919 to a value of $1.282.000.



LATHE ATTACHMENT FOR CUTTING OIL-GROOVES

The cutting of oil-grooves on internal or external surfaces of such parts as bearings, washers, shafts, arbors, etc., in shops where the quantity of work of this kind does not warrant the purchase of a machine especially designed for the purpose can be readily and economically accomplished by means of the lathe attachment illustrated diagrammatically in Fig. 1. It will be seen that the members of the attachment are the driving shaft *A;* the cast-iron bearing *B;* the cast-iron bracket *C*, which supports one end of the driving shaft *A* and arbor *E* on the end of which is forged the steel crank-plate *F;* connecting-rod *G;* and the steel part *H* employed to attach one end of rod *G* to the carriage. The attachment is mounted at the rear of the headstock end of a Reed-Prentice lathe, parts *B* and *C* being bolted to the bed.

With this attachment, when the spindle of the machine is rotated, a reciprocatory movement is given to the carriage due to the fact that the latter is connected to the crank-plate *F* by rod *G*. Thus, if the tool is properly set, a helical groove will be produced on the work. The distance that the carriage moves depends upon the amount that the adjustable end of rod *G* is set from the center of the crank-plate, it being obvious that if this end of the rod is set at the center of the plate, there will be no movement of the carriage because the rod will be stationary.

Various styles of grooves can be cut by merely changing the ratio of the gears connecting shaft *A* with the regular machine spindle. If these two gears are in a 1 to 1 ratio, there will be one complete reciprocation of the carriage to each revolution of the spindle, and a groove of the form shown at *A*, Fig. 2 will be produced on the work. If the gear mounted on the driving shaft is twice the diameter of that on the spindle, there will be but one reciprocation of the carriage during two revolutions of the spindle, and the groove will be in the form of an 8, as shown on the external surface at *B* and on the internal surface at *C*. By placing a gear on the driving shaft that is four times the diameter of the gear on the spindle, the latter will make four revolutions for each complete movement of the carriage, and the groove cut on the work will be as shown at *D* and *E*. If the gear on the spindle is twice the diameter of that on the driving shaft, there will then be two reciprocations of the carriage to each revolution of the spindle, and the groove produced will be of the type shown at *F*.

This attachment has given very good results; steel bearings 3½ inches in diameter and 2½ inches in length were machined at a production rate of four minutes per piece, floor-to-floor time, the oil-groove being of the type shown at *C*. The lathe on which the oil-grooving attachment is mounted can be conveniently arranged for ordinary work without disassembling the attachment, by simply removing either the gear from the driving shaft or that of the machine spindle,

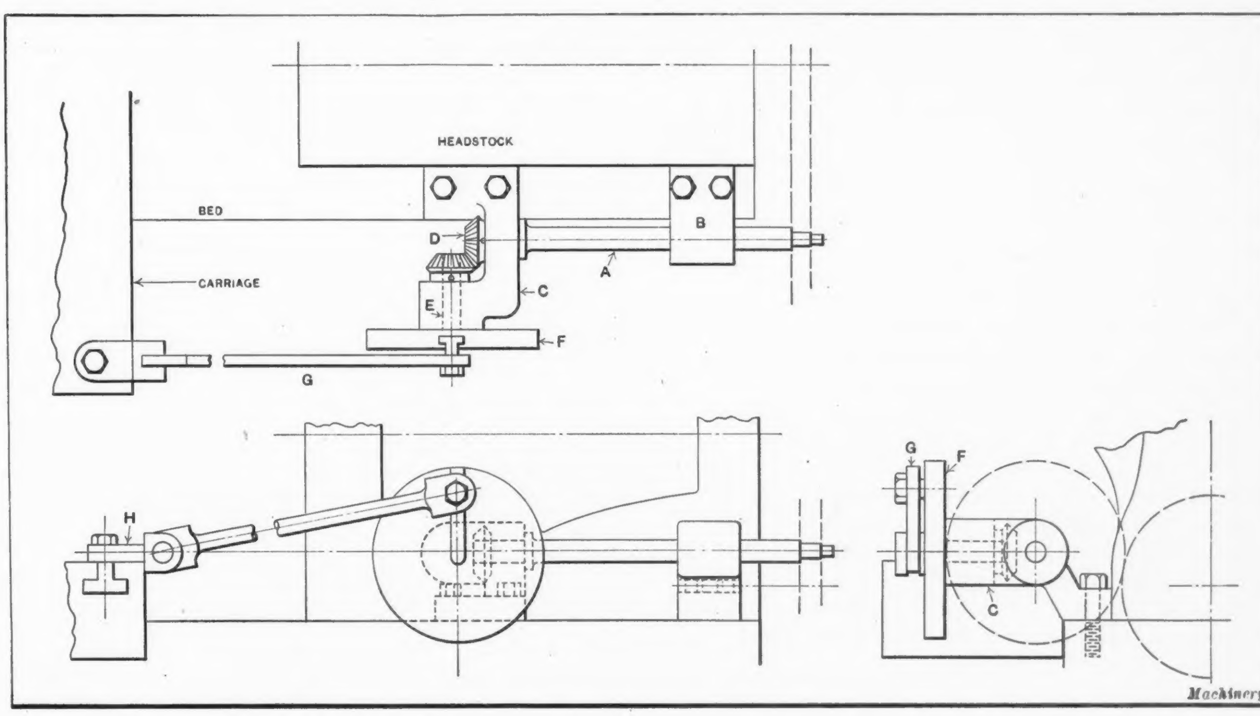


Fig. 1. Lathe Attachment for cutting Oil-grooves on Internal and External Surfaces

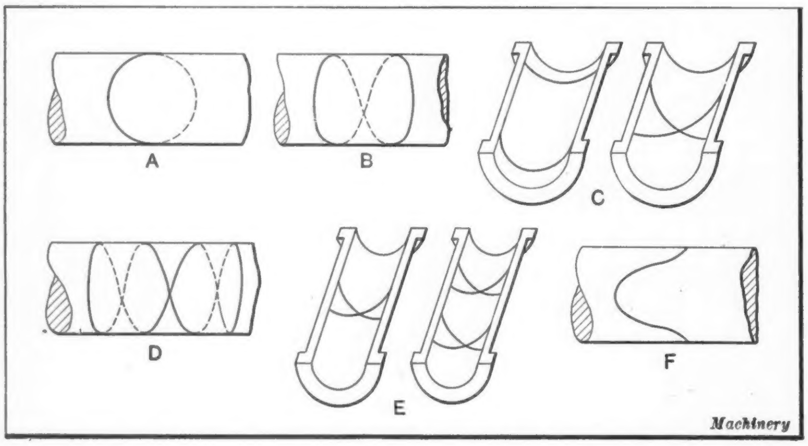


Fig. 2. Different Styles of Oil-grooves produced with Lathe Attachment shown in Fig. 1

and disconnecting rod *G* from part *H*. The maximum throw of the crank-plate on the attachment described was about 6¼ inches.

Sartrouville, Seine et Oise, France P. ROUQUET

STANDARD BLANKS FOR TOOL DRAWINGS

Where large quantities of tool drawings are used, they should be drawn on sheets of specified size, and should have standardized recording spaces for the entry of data. After having designed several such sheets for different offices and following up their use, the writer has developed the arrangement here presented which is believed to be excellent for general use. The function of such a form is to eliminate as much hand work in the drafting-room as possible, and also to draw attention to all necessary routine. While the annotations on the specimen (which is used by the draftsman in connection with making the drawing) are practically self-explanatory, some notes on the general arrangement and reasons for certain details may be added.

The sizes of sheets generally used and for which commercial filing cabinets are available are as follows: AA, 36 inches wide, any length (drawing folded to 24 by 36 inches); A, 24 by 36 inches; B, 18 by 24 inches; C, 12 by 18 inches; and D, 8½ by 11 inches (for small details and rough sketches accompanying letters). These dimensions are the outside dimensions of the sheet. A border line provides a ½-inch margin on all sides so that damaged and soiled edges will not mar the actual drawing. Referring to the illustration, the Change Record and the Bill of Material are put at the top of the sheet so that these lists can be filled in as required, adding more lines from time to time. To facilitate the adding of extra lines, marks are placed near the top of the right-hand border line of the sheet.

The tool number is usually sufficient identification and is filled in, in the lower right-hand corner of the sheet. A special series of numbers may be used for tools or, what is a preferable arrangement, the part number for which the tool is intended to be used may become the base number to which symbols are added. For example, part No. 529 requires, possibly, two jigs and one milling fixture. The general designation for jig is J and for milling fixture M, so that the tool numbers will be 529-J-1, 529-J-2, and 529-M-1. This method saves a great deal of cross-reference. Where the tools are used on several parts so that they cannot be identified by the number of any one part, the identification numbers must be selected from a general-use series.

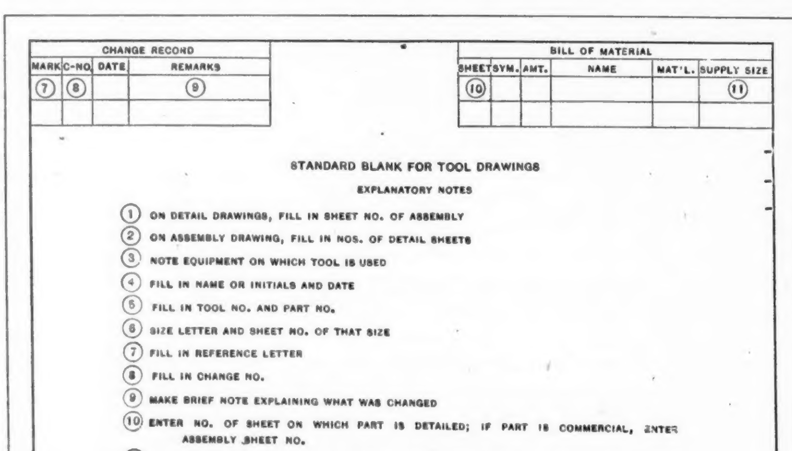
In a properly regulated establishment, no changes will be made without proper authority and without the maintenance of a suitable record. Usually this record is attended to by a change order in the form of a 5- by 8-inch slip, which is numbered and which is filed for reference after being used. The simplest numbering method for the change order is to use the tool number as a base and add an abbreviation for the change such as C, and the number of the change on the tool—that is, whether it is the first, second, or third change. Thus the second change order on jig 529-J-2 would be simply 529-J-2-C2.

The sheet numbers are usually made up by using the size letter and adding the number corresponding to the quantity of drawings of that particular size required for the tool. Thus, the second A size sheet will be A-2, and the first D sheet, D-1. Each sheet can therefore be filed numerically in a cabinet of its own size, so that any sheet can be quickly located. In cases where no special form is used, but each sheet is cut and ruled independently and as required, the direct labor involved alone will amount to approximately 50 cents a sheet. The result will also be affected, because the drawing will not be neat and it will not be produced as quickly as it would be if standardized sheets were furnished. A sheet that provides spaces for the majority of routine details will naturally eliminate much of this waste. The form here presented may be advantageously employed as a guide in arranging information relating to routine so that it will be in the most convenient form and insure against omissions.

Detroit, Mich. H. P. LOSELY

UNUSUAL BORING JOB

The illustration Fig. 1 shows a temporary set-up employed for what might ordinarily be considered a difficult boring job; with the arrangement shown, the work was successfully accomplished in good time. The job consisted of boring out a large condenser and the cylinders of a rolling mill horizontal high- and low-pressure steam engine. The position of the engine in the engine house made it difficult to perform the machining operation without dismantling it. However, it was practically impossible to dismantle the condenser and cylinders to have them bored, since the condenser



CHANGE RECORD			
MARK	C-NO.	DATE	REMARKS
7	8		9

BILL OF MATERIAL					
SHEET	SYM.	AMT.	NAME	MAT'L.	SUPPLY SIZE
10					11

STANDARD BLANK FOR TOOL DRAWINGS

EXPLANATORY NOTES

1 ON DETAIL DRAWINGS, FILL IN SHEET NO. OF ASSEMBLY
2 ON ASSEMBLY DRAWING, FILL IN NOS. OF DETAIL SHEETS
3 NOTE EQUIPMENT ON WHICH TOOL IS USED
4 FILL IN NAME OR INITIALS AND DATE
5 FILL IN TOOL NO. AND PART NO.
6 SIZE LETTER AND SHEET NO. OF THAT SIZE
7 FILL IN REFERENCE LETTER
8 FILL IN CHANGE NO.
9 MAKE BRIEF NOTE EXPLAINING WHAT WAS CHANGED
10 ENTER NO. OF SHEET ON WHICH PART IS DETAILED; IF PART IS COMMERCIAL, ENTER ASSEMBLY SHEET NO.
11 FILL IN SIZE TO BE CUT IN CASE OF STEEL ETC.; PATTERN NO. FOR CASTINGS; NECESSARY SIZES FOR COMMERCIAL PARTS.

DIMENSIONS IN INCHES FINISHED SURFACES ±0.010 TOLERANCE IF NOT OTHERWISE SPECIFIED	PART	DRN. 4	BLANK MACHINE CORP. IRONTOWN. TOOL DIVISION
SCALE IN. = 1 FT.	OPERATION	CHK. 4	
GEN'L. LAY-OUT 1	TOOL	APP. 4	MARK TOOL: TOOL NO. PART NO. 5
DETAILS 2	USED ON 3	SHEET NO. 6	

Machinery

Arrangement for standardizing the Entry of Data on Tool Drawings

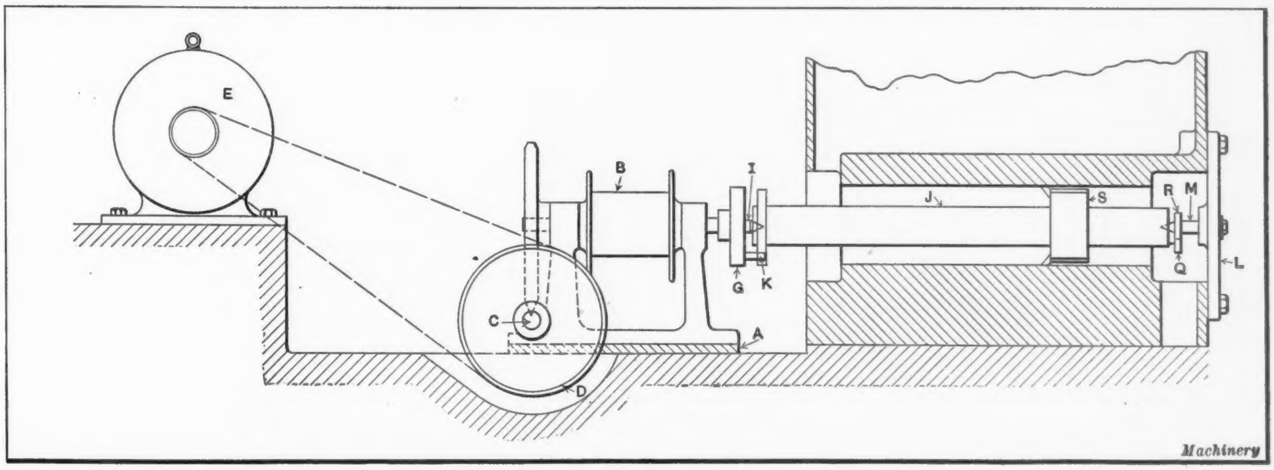


Fig. 1. Arrangement for boring Steam Engine Condenser without removing Engine from its Foundation

weighed about five tons and the cylinders were very difficult pieces to handle. It was finally decided to perform the boring operation by employing the special arrangement here described, and to do the work with the condenser and cylinders in place in the engine. This course was not decided upon, however, until it was evident that much time would be lost and that the mill in which the engine was installed would have to be shut down if the job were performed by an outside concern, which would require the cylinders and condenser to be dismantled.

The hole to be bored in the condenser was 9 inches in diameter and 4 feet 6 inches long. A baseplate *A* was first anchored to the foundation of the engine, on which was then bolted an old rope winch *B*. The winch was driven through worm-gearing, and on the end of the worm-shaft *C* a pulley *D* of suitable size was attached. The power was furnished from a five-horsepower electric motor *E* running at a speed of 960 revolutions per minute, the pulley of which was connected to the driving pulley on the worm-shaft by a 3-inch belt, the speed reduction being 3 to 1. The worm-gearing ratio of the winch furnished a further reduction of 40 to 1, so that the speed of the boring-bar was 8 revolutions per minute. The cast-iron driver plate *G*, carrying a hardened steel center *I*, was keyed to the end of the drum shaft of the winch, as shown in the illustration, so that by employing an ordinary lathe dog *K*, a suitable driving means was provided for the boring-bar *J*.

The opposite end of the boring-bar was similarly supported by center *M* carried in the end plate *L*. The end plate was attached through the same holes that were used for holding the end cover to the condenser. The boring-bar, as will be seen by referring to Fig. 2, was of the ordinary self-feeding type, with feed-screw *P* and nut *T* for traversing the tool-holder *S*. The tail end of the feed-screw carried a small pinion *Q*, driven by a gear *R* attached to center *M*. The tool-holder carried six tools, and provision was made for boring larger diameters by attaching another tool-holder to the outside of tool-holder *S*. The condenser was in line with the high-pressure cylinder of the engine, so that to bore out this cylinder all that was necessary was to provide a coupling bar to extend through the condenser. This same arrangement was employed for boring out the low-pressure cylinder. The whole job required one week, and the engine was again at work within two weeks.

Cleveland, Ohio — C. F. George

GRINDING-WHEEL SPINDLES

The writer has read with interest the article appearing on page 374 of the December, 1920, number of MACHINERY. It is believed, however, that there should have been included in the description some reference to the fact that the designs illustrated are intended for internal grinding. The type of spindle shown in Fig. 1 of the previously mentioned article is used in the Plainville plant of the Standard Steel & Bearings Co., in manufacturing S.R.B. bearings, in which plant it is the writer's belief this design was developed. The spindle proper was made of tool steel (hardened and drawn to relieve strains, and ground all over for balance) and not of casehardened machine steel. Ball grooves ground in these spindles, consequently, have the same relative advantage over a casehardened bearing as a tool-steel ball bearing would have. The bearing cups were also made of tool steel, with their tapered portions lapped.

In regard to the results which a spindle of this design furnishes, it can be said that they are not altogether satisfactory. Spindles of this type require frequent adjustment, so that when they are put to continuous service (as they would be if the shop were operating on a shift schedule), it would be necessary to have a number of competent high-priced men available to make the proper adjustments necessitated by wear. In compensating for wear, it is necessary to remove the spindle and regrind the ball races. It is also necessary to maintain a copious supply of oil in the bearing housing, for upon this degree of lubrication depend the amount of heat generated, the consequent expansion of the spindle, and the resulting effect on its running qualities. This design of spindle was also tried with a large wheel for external work and was found unsatisfactory for this kind of grinding service.

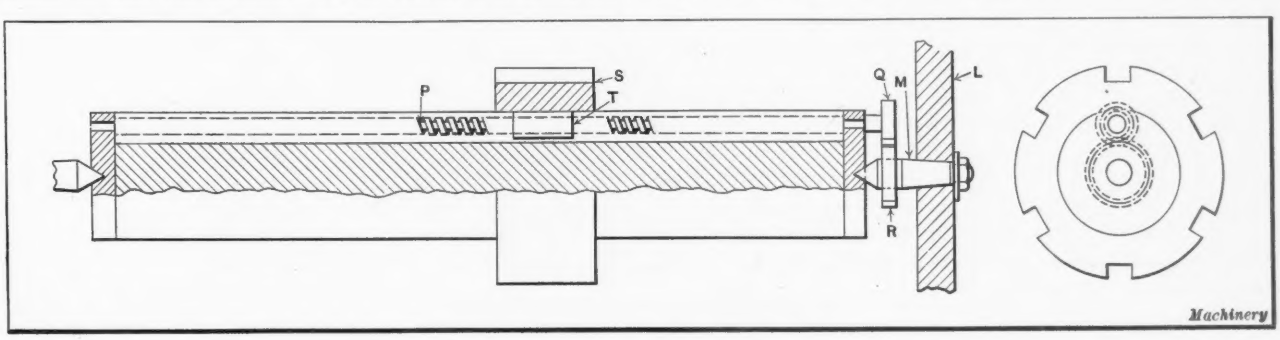
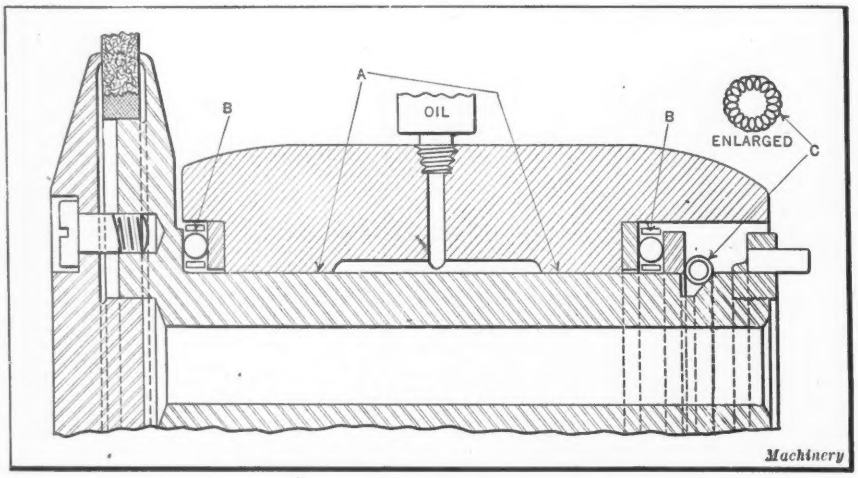


Fig. 2. Self-feeding Type of Boring-bar used in boring Engine Condenser and Cylinders



Design of Grinding-wheel Spindle Suitable for Use on External Work

For external work, a rather novel grinding-wheel spindle design was developed in the previously mentioned plant, as shown in the accompanying illustration. The spindle proper is made of tool steel, hardened and ground all over, and is mounted in a cast-iron housing *A*. This bearing is reamed and then burnished with a ball broach. Ball thrust bearings *B* are provided at each end as shown, the one at the rear of the spindle being backed up by a coiled spring formed into a loop and located in a suitable groove in the spindle proper, as indicated at *C*. The function of this spring is to compensate for expansion and wear of the spindle. This spindle is driven through a flexible coupling from an electric motor, and runs at approximately 1200 revolutions per minute, under which conditions it gives very satisfactory results for radial-grinding the cone grooves in ball bearings. This design, however, was not considered satisfactory for lapping these grooves, the lapping operation being performed on a No. 2 B. & S. universal grinder equipped with a special attachment.

New Britain, Conn. C. R. Wells

IMPORTANCE OF MARKING PATTERNS AND CORE-BOXES

Over-emphasis cannot be laid upon the importance of marking patterns, core-boxes and their loose pieces in such a manner that the parts required for molding any particular casting can be readily identified and that the molder and core-maker will have no difficulty in understanding just how the loose pieces are to be assembled. In cases where a pattern and several core-boxes having a number of loose pieces are required for a casting, the work of the core-maker and molder is far from easy unless all the pieces are adequately marked so that guesswork is eliminated. Frequently, a patternmaker neglects to do this marking if the job happens to be in a hurry or if only one or two castings are to be made, it being thought that verbal instructions to the foundrymen will suffice. However, such instructions are sometimes given to an office employe who does not thoroughly understand them, or if given to a foundryman they are likely to be forgotten by the time the cores are to be made or the casting molded. This is especially true if another similar casting is required after several months or years have elapsed.

It is not always the fault of the patternmaker that his work is not marked; sometimes he is so instructed by his foreman or superintendent for various reasons. The following incident shows that much confusion and the loss of castings are sometimes the result when the assembly of the loose pieces of a pattern and its core-boxes is not understood in the foundry. The pattern and core-boxes for a large four-way hydraulic valve were made in a hurry and sent to the foundry without markings. The casting to be produced was quite complicated from a molder's viewpoint, as the pattern had five loose pieces and there were seven core-boxes having a total of nine loose pieces. Yellow varnish spots on the pattern and core-boxes indicated where loose pieces were to be attached, but there were no markings showing which loose piece corresponded to a particular varnished spot. However, by means of verbal instructions, three castings were successfully produced, the pattern and core-boxes being then sent to the pattern loft for storage.

Ten months later another similar valve was desired for a repair job, and the pattern and core-boxes were returned to the foundry for the purpose of constructing the necessary mold. Here it was found that the previous jobs and the long storage had succeeded in almost entirely obliterating the varnished spots. As there were no other markings to indicate how the loose pieces were to be assembled, the molder and core-maker resorted to guesswork, the result being that the core-maker erred in preparing one of the cores so that the casting was produced wrong. The mistake was not discovered until after the valve had been sent to the machine shop and partially finished. A delay of three days was experienced before another casting was made, to say nothing of the loss of time and labor spent on the spoiled casting.

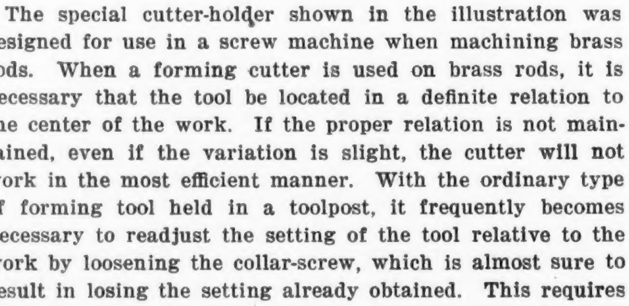
Kenosha, Wis. M. E. Duggan

HOLDER FOR FORMING CUTTER

The special cutter-holder shown in the illustration was designed for use in a screw machine when machining brass rods. When a forming cutter is used on brass rods, it is necessary that the tool be located in a definite relation to the center of the work. If the proper relation is not maintained, even if the variation is slight, the cutter will not work in the most efficient manner. With the ordinary type of forming tool held in a toolpost, it frequently becomes necessary to readjust the setting of the tool relative to the work by loosening the collar-screw, which is almost sure to result in losing the setting already obtained. This requires that the setting of the tool in the correct position be done all over again.

When using the holder illustrated, the cutter is set as nearly right as possible, after which the position in which the tool will work best is obtained by raising or lowering the tool by means of its adjustable feature. It will be seen that this fine adjustment is obtained by means of a headless set-screw, which bears against the rear side of the tool bit. This cutting member has a tongue 1/16 inch deep which fits a corresponding groove in the holder, thereby furnishing a guide in the radial adjustment of the tool bit. Since the tool bit is seated on an angular surface, it will be apparent that only a comparatively light pressure is required to be exerted by the collar-screw in order to hold the forming cutter securely.

Montreal, Canada Harry Moore



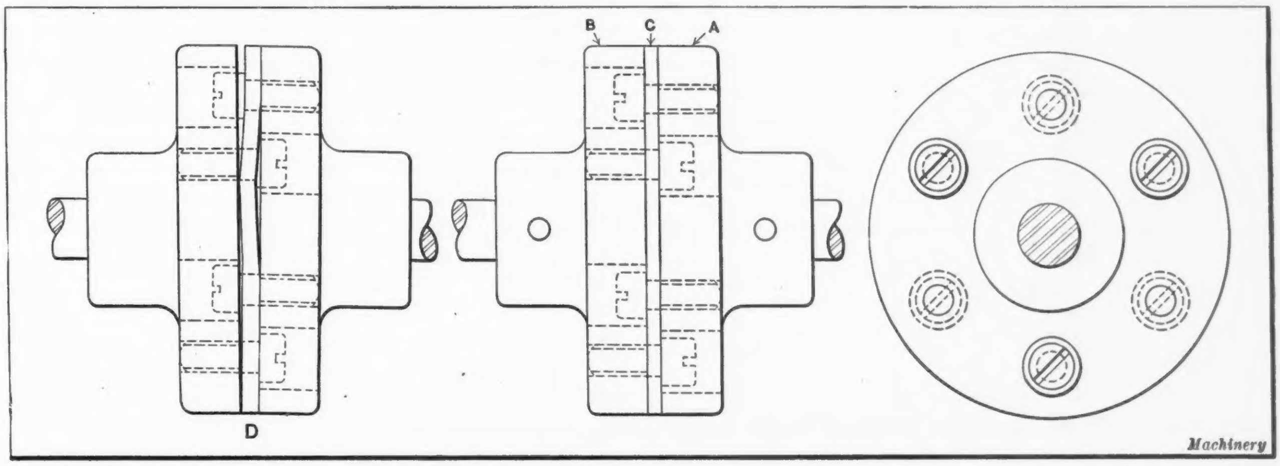
Holder with Provision for adjusting the Cutter

FLEXIBLE COUPLING

A flexible coupling which may be made without great expense and which is efficient and of simple design is shown in the accompanying illustration. This coupling will be found useful in the transmission of light loads, such as the service required in coupling small dynamos and motors. The device consists of two flanged coupling members *A* and *B*, which are secured to the ends of the shafts by any convenient means, such as pins passing through the hubs of the members. Each of these coupling members contains a number of holes for the accommodation of fillister-head cap-screws, the quantity depending upon the size of the coupling. In the illustration, three screws are used in each coupling member. The members are arranged in assembly with the cap-screw holes in one offset with relation to those in the other, as shown in the end view in the illustration. The holes that accommodate the heads of the cap-screws should be somewhat larger in diameter than the size of the head, so as to permit movement of the two parts.

Between the adjacent faces of the flanged members, there is a ring *C* which may be made either of spring steel or leather, and which is provided with holes of the proper size to permit its assembly to the two coupling members by means of the cap-screws. This ring is secured to the coupling members in such a manner that every other screw holds the ring to one of the members and the remaining screws to the other member. This provides an arrangement whereby the parts are free to move out of alignment, as indicated in the view at *D*, owing to the flexibility of the ring. This coupling contains no loose parts and operates without noise or backlash.

Poughkeepsie, N. Y. JOHN J. THOMPSON



Flanged Coupling of Simple Construction permitting Flexibility

HELICAL SPRING DESIGN

Recently the writer had occasion to design a helical recoil spring for a gun of American make. This spring was to have the same outside diameter and carrying capacity as one used in a similar gun of French manufacture. The spring used in the French gun was made from ½- by ⅝-inch stock, and had a 3-inch outside diameter and a solid height of 20 inches. These English system dimensions are, of course, the nearest to the metric dimensions for the spring used in the French gun.

The spring was required to be made of round wire of such a size that the dimensions and strength of the rectangular stock spring would be duplicated, and the solid height of 20 inches be retained as near as possible. The different formulas for rectangular bar springs were tried with varying success, so that in order to arrive at more satisfactory results, it was decided to investigate with a view to deriving a new formula.

The deflection and carrying capacity of a spring are governed by the torsional strength of the material from which it is made, and this strength is determined by the polar section modulus Z_p of the section.

For a rectangular section, $Z_p = \dfrac{2}{9} bd^2$

For a circular section, $Z_p = \dfrac{\pi D^3}{16}$

In these formulas

b = long side;
d = short side; and
D = diameter of wire.

Equating the values of Z_p in the above formulas,

$$\frac{\pi D^3}{16} = \frac{2}{9} bd^2$$

from which

$$D^3 = \frac{2}{9} bd^2 \div \frac{\pi}{16}$$

$$= \frac{2 \times 16}{9 \times 3.1416} bd^2 = 1.1317bd^2$$

$$D = \sqrt[3]{1.1317bd^2}$$

From the conditions of the problem, this equation may now be written

$$D = \sqrt[3]{1.1317 \times 0.625 \times 0.5^2}$$

or

$$D = 0.56 \text{ inch}$$

A 9/16-inch diameter rod will, then, give the required results if the mean diameter of the spring (3 — ⅝, or 2⅜ inches) is retained. In this particular problem, however, the mean diameter must be changed, since the outside diameter is to remain the same. Using the well-known spring formulas for load W and deflection F,

$$W = \frac{0.4Sd^3}{D - d} \qquad F = \frac{3.14S(D - d)^2}{Gd}$$

in which W = safe load;
F = deflection per coil;
d = diameter of wire;
S = safe tensile strength of the material in pounds per square inch; and
G = torsional modulus of elasticity.

If the tensile strength is taken at 80,000 pounds per square inch and the torsional modulus of elasticity at 12,000,000

$$W = \frac{0.4 \times 80{,}000 \times 0.5625^3}{2.375} = 2399.3 \text{ pounds}$$

$$F = \frac{3.14 \times 80{,}000 \times 2.375^2}{12{,}000{,}000 \times 0.5625} = 0.2 \text{ inch}$$

The number of coils in the rectangular spring is equal to the solid height divided by the short side of the rectangular stock, or 20 ÷ 0.5 = 40, which multiplied by the deflection per coil, 0.2 inch, gives a total deflection of 8 inches.

The mean diameter of the 9/16-inch diameter wire spring is 2 7/16 inches, so if this value is inserted in the preceding equations for safe load and deflection per coil, the safe load of the spring is seen to be 2333 pounds and the deflection per coil 0.21 inch. The difference in allowable load for the two springs is 66 pounds, which indicates that the size of the wire should be increased somewhat in order to meet the requirements of the original spring. If the value of d may be expressed in terms of the safe load formula, thus

$$d = \sqrt[3]{\frac{W(D-d)}{0.4S}}$$

and the corresponding numerical values are substituted in this formula, then

$$d = \sqrt[3]{\frac{2399.3 \times 2.4375}{0.4 \times 80{,}000}} = 0.5674 \text{ inch}$$

It will be seen that this is not a standard size for wire and that it represents only an increase of about 0.005 inch over standard 9/16-inch diameter stock spring. This slight diameter difference and the fact that the difference in the safe loads of the two springs represents but a decrease of 2¾ per cent, make it evident that the round wire spring will, under normal conditions, meet the requirements. This spring corresponds closely with the values given for springs of this size wire on page 428 of MACHINERY'S HANDBOOK.

Dividing the total deflection by the deflection per coil and multiplying the result by the diameter of the wire, gives the solid height: Thus $(8 \div 0.21) \times 9/16 = 21\frac{3}{8}$ inches. The total deflection H will be somewhat less than 8 inches if the original solid height of 20 inches is retained, as will be seen from the following equation:

$$H = \frac{20 \times 0.21}{0.5625} = 7.46 \text{ inches}$$

Baltimore, Md. H. R. BOWMAN

FOLLOW-DIE FOR EIGHT-SPOKE WHEEL

In Fig. 1 is shown the plan view of a follow-die designed to pierce and blank the eight-spoked wheel shown at A, Fig. 2. This die, however, proved unsatisfactory in use, due to the weakness of sections B, Fig. 1, which correspond to the spokes of the wheel. In order to overcome this difficulty, the follow-die shown at E, Fig. 3, was designed. The spokes are formed by this die in two piercing operations instead of one, as in the case of the die shown in Fig. 1. From view E, Fig. 3, it will be seen that the latter die is constructed so that alternate spaces are pierced by each of the multiple piercing punches.

In laying out the die, a plate G, shown in Fig. 2, was first cut from ⅛-inch sheet stock. A circle with a radius equal to the diameter of the wheel plus the bridge between the blanks was next scribed on the plate. This circle was then divided into eight equal parts. A 0.125-inch hole was next drilled at each of the division points and also at the center of the circle. The spokes of the wheel were next laid out on the plate by the use of a straightedge and two 0.125-inch drills, in the following manner: As the width of the spokes corresponds to the diameters of the equally spaced holes, it was only necessary to insert the shanks of the two 0.125-inch drills in diametrically opposite holes so that the straightedge could be located against the sides of these drills when the lines were being scribed for determining the width of the spokes.

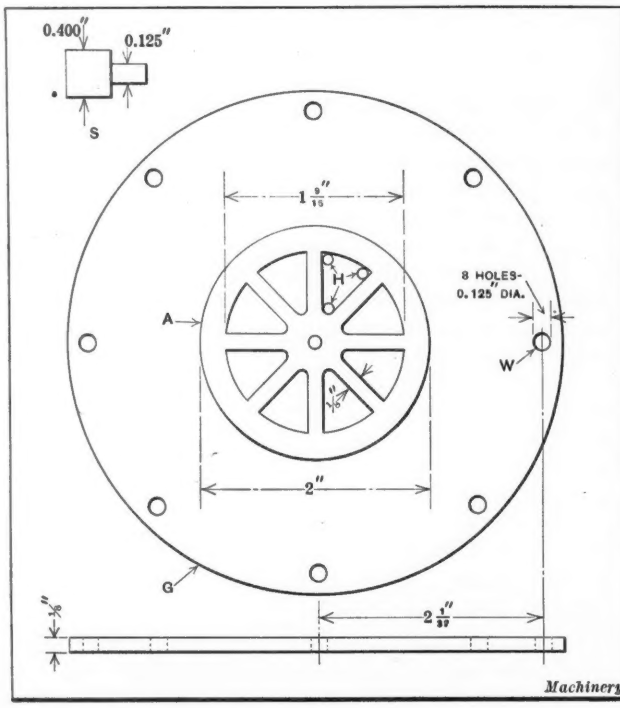


Fig. 2. Lay-out Plate used in making the Spoked Wheel Die

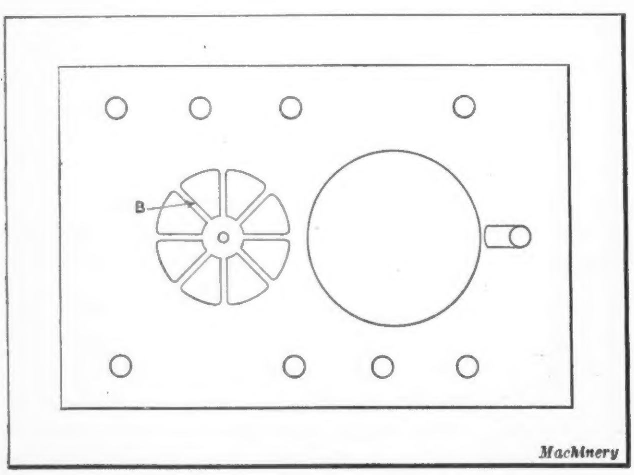


Fig. 1. Plan View of Die originally used in the Production of a Spoked Wheel

Three holes H were next laid out and drilled, being so located that they could subsequently be used when cleaning out the space between the spokes on the plate. The center distances between the two piercing dies and the blanking die were then located by means of the plate on a piece of water-hardening vanadium steel, which was to be used for the die. Holes 0.025 inch in diameter were next drilled at each of these three centers, care being taken to have them lined up accurately. The plate was then employed as a drill jig for drilling holes in the die such as indicated at K, Fig. 3. By using the shank of a drill as an arbor and the shank of another drill as an indexing pin for plate G, it was a simple matter to properly locate and drill four similar groups of holes about each piercing die center.

The three holes in each group thus drilled located the corners of the openings forming the piercing dies. For example, the holes at each corner of opening L, Fig. 3, were drilled by using plate G, Fig. 2, as a drill jig in the following manner: First the shank of a 0.125-inch drill was passed through the central hole of plate G and into hole O, Fig. 3, of the die; next the shank of another drill was inserted in hole W of plate G, Fig. 2, and pushed into hole P, Fig. 3, of the die, which was located previously by means of plate G; next the three holes corresponding to holes H, Fig. 2, were drilled through the die, using plate G as a drill jig. By properly indexing plate G and repeating the drilling operations, it was a simple matter to locate the corners of each opening accurately. After all the holes were drilled, the metal was worked out between the three holes in plate G in order that the plate could be used as a gage for filing out the die.

In the upper left-hand corner of Fig. 2 is shown a solid button S which was used in connection with the grinding

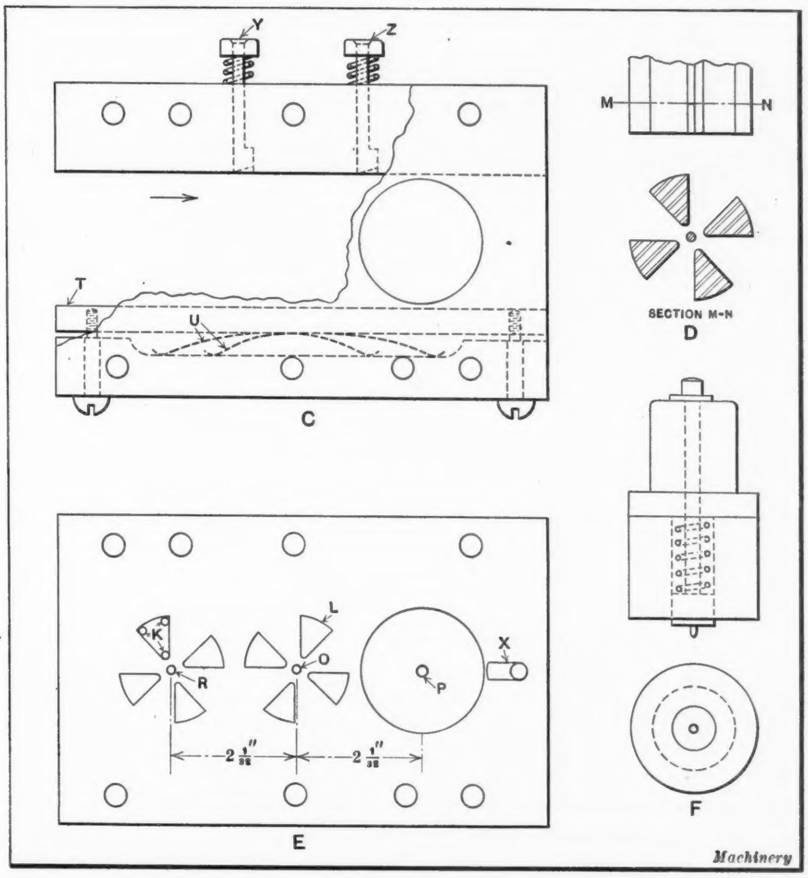


Fig. 3. Stripper, Follow-die, and Punches of Improved Design

of the blanking die. This button has the same diameter as that of a commonly used jig button and also a 1/8-inch pilot made to fit the punch holes *R* and *O* in the die, Fig. 3. Two of these buttons were made and used in the following manner: The pilot of one button was placed in hole *R* and the pilot of the other in hole *O;* a regular locating button was then attached to a piece fitted into the previously rough-bored blanking die hole; then by the use of the straightedge and a micrometer, the 0.400-inch diameter locating button was brought into accurate alignment with the two buttons in holes *R* and *O* respectively, so that the jig button could be used for indicating up the work with the machine spindle when grinding the blanking die.

At *D*, Fig. 3, is shown a sectional view of one of the piercing punches, and at *F* the blanking punch, while *C* is a view of the stripper plate used with the die. This plate is provided with a guide strip *T* actuated by flat springs *U*, which keeps the strip stock pressed against the opposite side of the stripper block, thus compensating for variations in the width of stock. The stops *Y* and *Z* are used only when starting the stock, *Y* being used to locate the work for the first piercing operation and *Z* for the second operation. After the stock is properly started, stop *X*, shown in view *E*, locates the work in the proper position for each succeeding stroke of the punch.

Brooklyn, N. Y. HOWARD W. HOUSE

URGENT NEED FOR STANDARDIZATION OF NUTS AND BOLT HEADS

Exasperating situations frequently arise because of the differences in the distance across the flats of nuts and bolt heads for the same basic size of bolt but of a different manufacture. On this account, if a mechanic endeavors to use a non-adjustable open-jaw or socket wrench for loosening a nut, the nut will probably be too large to permit the wrench to be placed on it, or else the nut corners will become rounded when the wrench is turned. No blame can be attached to the manufacturers of the wrenches because they make them to suit some one of the many different standards. The whole blame rests upon the users of bolts and nuts, inasmuch as they do not compel the trade to make all bolt heads and nuts for the various sizes of bolts, to a single standard. Of course a minus tolerance should be permitted on the nut and bolt-head dimensions for manufacturing reasons, and incidentally it might be stated that a plus tolerance should be given on the wrench openings.

In order to obtain an idea of the number of so-called "standard" dimensions across the flats of a nut or bolt head, reference need only be made to any of the mechanical engineering handbooks. It will be seen, for instance, that for a 5/8-inch diameter bolt, there may be as many as seven dimensions for the width across the flats of the hexagonal nut or head for this size of bolt. The Society of Automotive Engineers has developed bolt-head and nut standards, but these are not used exclusively in the construction of most automobiles. The S. A. E. sizes do not conform to those of the U. S. standard, and neither of them are in accordance with the standards of various manufacturers. The accompanying table shows the dimensions of hexagonal bolt heads and nuts taken from tables given in several well-known handbooks. The standards to which the dimensions in the various columns of this table apply are as follows:

Column A—U. S. standard hot-pressed and cold-punched nuts; U. S. standard rough nuts; and U. S. Government standard finished heads and nuts.

Column B—U. S. standard finished nuts; and manufacturers' standard machine bolt heads and nuts.

Column C—Cap-screws—Hartford Machine Screw Co. and U. S. Navy standard.

Column D—Manufacturers' standard hot-pressed and cold-punched nuts.

Column E—Manufacturers' standard narrow-gage hot-pressed nuts.

Column F—Whitworth nuts and heads.

Column G—Society of Automotive Engineers' standard.

The writer is of the opinion that by inspection of the data given in this table, a realization will be obtained of the absurdity of having such a variety of dimensions for a given bolt diameter. In addition, it should be stated that the U. S. Government has approved two standards, and the U. S. Navy has its own standard, which makes in all, three government standards where one is sufficient. It is believed that an appeal should be made to the manufacturers of bolts and nuts to have them request such organizations as the Society of Automotive Engineers, the American Society of Mechanical Engineers, or the United States Bureau of Standards, to recommend the use of a single uniform standard for the dimensions discussed in the foregoing. S. J.

DIMENSIONS ACROSS FLATS OF HEXAGONAL BOLT HEADS AND NUTS OF VARIOUS STANDARDS*

Bolt Size	A	B	C	D	E	F	G
1/4	1/2	7/16	7/16	1/2		0.525	7/16
3/8	11/16	5/8	9/16	3/4	11/16	0.710	9/16
1/2	7/8	13/16	3/4	1	7/8	0.920	3/4
5/8	1 1/16	1	7/8	1 1/4	1 1/8	1.100	15/16
3/4	1 1/4	1 3/16	1	1 3/8	1 1/4	1.300	1 1/16
7/8	1 7/16	1 3/8	1 1/8	1 5/8	1 1/2	1.480	1 1/4
1	1 5/8	1 9/16	1 1/4	1 3/4	1 5/8	1.670	1 7/16

Machinery

*All dimensions in inches

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

PROBLEM INVOLVING ALGEBRA AND TRIGONOMETRY

R. T. R.—In the accompanying illustration, $a = 1\frac{1}{4}$ inches, $h = 4$ inches, and angle $A = 12$ degrees. Please show how to find distance x and angle B.

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—According to trigonometry,

$$x = h \tan B \quad (1)$$

and

$$\operatorname{Tan}(A + B) = \frac{a + x}{h} \quad (2)$$

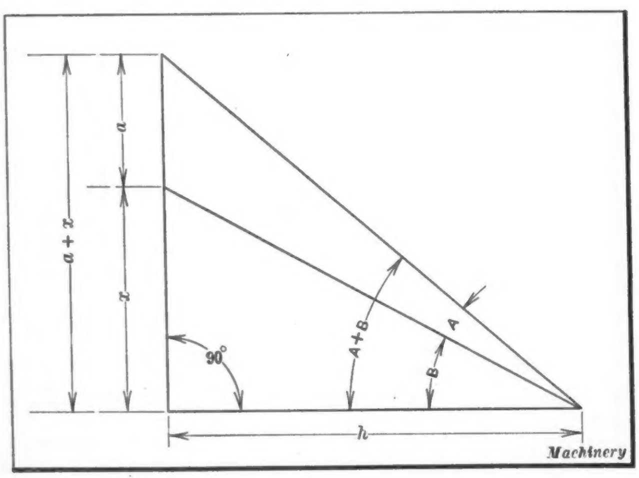


Illustration used in Algebraic and Trigonometric Problem

A number of important trigonometric formulas are given on page 154 in MACHINERY'S HANDBOOK among which is the following:

$$\operatorname{Tan}(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

Substituting this value for tan $(A + B)$, Equation (2) becomes

$$\frac{\tan A + \tan B}{1 - \tan A \tan B} = \frac{a + x}{h} \quad (3)$$

Now substituting the value of x from Equation (1), Equation (3) becomes,

$$\frac{\tan A + \tan B}{1 - \tan A \tan B} = \frac{a + h \tan B}{h}$$

Clearing of fractions,

$$h(\tan A + \tan B) = (a + h \tan B)(1 - \tan A \tan B)$$

Expanding, combining like terms, and factoring,

$$\operatorname{Tan} A\,(h \tan^2 B + a \tan B) = \tan A \left(\frac{a}{\tan A} - h\right)$$

Eliminating the factor tan A, substituting cot A for $\frac{1}{\tan A}$ and arranging terms,

$$h \tan^2 B + a \tan B - (a \cot A - h) = 0$$

Solving this quadratic equation for tan B,

$$\operatorname{Tan} B = \frac{-a \pm \sqrt{a^2 - 4h(h - a \cot A)}}{2h}$$

Taking this equation with the plus sign before the radical and simplifying the terms under the radical,

$$\operatorname{Tan} B = \frac{\sqrt{(a + 2h)(a - 2h) + 4ah \cot A} - a}{2h} \quad (4)$$

Inserting numerical values in Equation (4),

$$\operatorname{Tan} B = \frac{\sqrt{94.0926 - 62.4375} - 1.25}{8}$$

$$= \frac{4.376286}{8} = 0.5470358$$

and

$B = 28$ degrees 40 minutes 49 seconds

Now inserting the known values in Equation (1),

$$x = 4 \times 0.5470358 = 2.1881 \text{ inches}$$

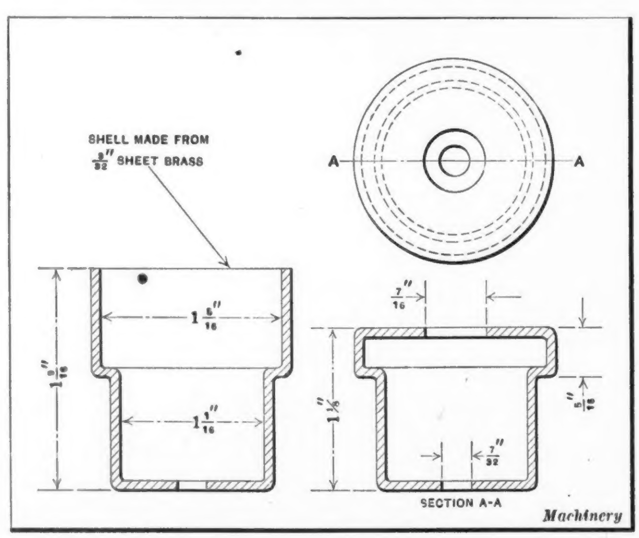
DEFINITION OF A SPLINE

K. S. A.—Disputes occasionally arise as to whether a spline is the groove into which a key extends or whether it is the key itself. Kindly explain the correct use of the term.

A.—According to the Century dictionary, a spline is "a rectangular piece or key fitting into a groove in the hub of a wheel and in a similar groove in a shaft, so that while the wheel may slide endwise on the shaft, both must revolve together." From this definition, a spline is the key and not the keyway. However, according to Webster's dictionary, a spline is a "feathered key or a keyway for a feather key." This makes it permissible to use the word spline to designate either key or keyway; but to avoid confusion, this practice should be discouraged, and the Century dictionary definition adhered to.

FORMING DIE PROBLEM

R. A. B.—Referring to the accompanying illustration, can someone explain the construction of a die or tool of some type for forming or closing in the end of the shell shown at the left, so that it will have the form indicated by the view at the right? The shell is made from 3/32-inch sheet brass and the problem is to form it by some method other than metal spinning, assuming that the latter is practicable.



Shell for which Forming Die is desired

This problem is submitted to MACHINERY'S readers. If anyone has performed a similar operation with satisfactory results we should be glad to have them submit a description of the tool or method employed, for publication.

The Automobile Industry

The automobile industry is passing out of the spectacular stage in much the same way as the bicycle industry did some twenty odd years ago. From now on it is likely that the manufacture of automobiles will become simply one of the many great industries of the country, each of which fills an important and necessary place in the nation's life and development. As it is one of the most important of the industries using machine tools, it is of value and interest to machine tool manufacturers to review briefly its past performance, and analyze the present conditions and the probable future outlook in the automobile field.

THE year 1920 was one of unusually high production in the automobile industry, due to the general prosperity of the country during the better part of the year. Toward the end of the year, there was a marked and sudden change. The buying public became conservative in the matter of purchases of all kinds, and the automobile industry suffered along with the rest of the great industries of the country. Now the industry may be said to be passing through a crisis from which it will emerge stronger and healthier, and it will occupy a more normal position that it ever has before.

Statistics of the Automobile Industry

The automobile industry is accorded the second place in the manufacturing industries of the country, both in regard to the capital invested and the value of its product. At the end of 1919 the capital invested in the automobile industry, exclusive of parts and accessories makers, was over $1,000,000,000. The total number of motor vehicles made was 1,974,000, the value of which was $1,885,000,000—a sum which is equal to the value of the total annual production of coal in the United States. The total number of men employed was 300,000, and the annual payroll was about $375,000,000. It is estimated that in 1920, not less than 2,250,000 automobiles were built.

The total number of automobiles and motor trucks in use in the United States today is estimated at 7,000,000. A census taken by the National Automobile Chamber of Commerce indicates that of the passenger automobiles, only 10 per cent are used exclusively for pleasure, and that 90 per cent are used more or less for business purposes. Sixty per cent of the average car mileage, and 78 per cent of the car mileage of automobiles owned by farmers, is credited to business purposes. Replies received from farmers showed that in their estimation the automobile added, on an average, 65 per cent to the efficiency with which they could conduct their work.

It is estimated in the automobile trade that if the market for new automobiles were confined merely to replacements, 1,000,000 automobiles would be needed every year. This, added to the demand for automobiles by people who are not replacing old cars, would insure a steady business in the automobile industry. Altogether, 11,500,000 automobiles have been sold in the United States, but it is estimated that about 4,500,000 have been scrapped. Since 1899 about 12,000,000 automobiles have been manufactured in this country, and 9300 have been imported. About 525,000 have been exported. In 1920 only 200 foreign cars were imported, and about 120,000 American cars were exported. Of the cars exported in 1920, approximately 20,000 went to the United Kingdom, 12,000 to British India, 8000 to Canada, and 6000 to Cuba.

Present Conditions in the Automobile Industry

During December and January many of the automobile shops were entirely closed down, while others worked a few days a week with but a fraction of their normal working force. In most cases, the work at that time consisted either in supplying repair parts or in assembling cars from parts already manufactured. In the month of February there was a distinct improvement in conditions not only in Detroit—the great automobile center—but also in most of the other cities and towns where automobiles are manufactured.

The conditions in Detroit may be considered as a fair indication of the conditions in the entire industry. In the last week of February, 27 per cent of the total number of workers employed in the automobile and allied industries in that city previous to the depression, were at work. In some plants the production was as high as 50 per cent, while in others it was not more than 10 per cent. During March, a considerable number of men were put to work and it is believed that in the early part of April, the productive capacity of the automobile plants in Detroit will be increased to an average of 35 per cent, and that this increase will continue until at least 50 or 60 per cent of the capacity will be taken care of in the early months of the summer.

During the period when the plants were shut down, the automobile manufacturers accumulated a number of orders, and it is believed that at the rate at which the plants are operated they will barely be able to cope with the orders so far received and those yet to be placed for spring buying. It is estimated that during the coming year, the total number of automobiles built by all automobile manufacturers of the country will be about 40 or 50 per cent of the number built in 1920, or approximately 1,000,000 cars.

The high estimate placed by automobile builders upon replacements is doubtless somewhat optimistic, because the present tendency is to make a car last longer than in the past. Mechanically, automobiles are so perfected that their life is much greater than formerly, and whereas it has not been unusual in the past for automobile owners to acquire a new car at least every other year, many users are now expecting modern cars to last twice that length of time or more. Even then, the car is not worn out, but is worth a fair price in the second-hand market and can be used for several years more.

Prospects in the Automobile Industry

The question that naturally arises is this: If the automobile factories are to turn out only half of their 1920 capacity in 1921, how are they going to keep their large plants occupied? To answer this question definitely is of course impossible, but the most likely development is that automobile manufacturers in the future will make more of the parts for their automobiles in their own plants than they have in the past, and will thereby be able to take care of practically all of their plant capacity.

The part makers will doubtless suffer the most, because the demand upon them will be greatly lessened. Some plants devoted to the making of automobile parts in the past will have to be diverted to other industrial uses. It is reasonable to believe that the automobile industry, instead of occupying the center of the stage, will take its appropriate place in the industrial world. Some of the other industries that have been rather in the background during the last few years will develop and increase so that they will require, to some extent at least, some of the manufacturing facilities already available. It must also be remembered

that the tractor has only begun to be recognized as a factor in our agricultural life. Its future is doubtless one of the greatest importance.

Improved Methods and Reduced Costs

As the automobile industry works out its problems during the coming years, it is likely that there will be a reduction in manufacturing and selling costs which will gradually be reflected in a reduction in prices of automobiles. This will make the better grade of cars available to an ever-increasing number of users, thereby placing the automobile industry on a firmer footing than ever. In spite of the highly developed methods in the automobile industry, there is still in many cases an opportunity for a decrease in the manufacturing costs, particularly in the case of the higher priced cars. And all will agree that there is an opportunity for a decrease in the selling costs, as the methods of selling automobiles are exceedingly costly, practically no attempt having as yet been made to economize in this direction.

In meeting the new conditions, wage reductions are necessary. Wages in the automobile industry have been abnormally high, causing a great deal of difficulty to manufacturers in other lines. In Detroit, as well as in other automobile centers, wages in the automobile plants are being reduced on an average 20 and 25 per cent, and if these reductions do not bring the level of wages to a point where workers in this industry receive the same compensation for the same class of work as in the other industries, further wage reductions may be expected.

In the buying of materials and supplies, the automobile manufacturers at the present time are exceedingly conservative. They look forward to further reductions in the prices of both steel and other materials, and there is every evidence that in the future the automobile industry will be conducted with that same strict economy that has been necessary in the past in other competitive industries.

The foregoing paragraphs are an attempt to give a perspective view of the present situation in the automobile field. The outlook is distinctly hopeful, and the crisis that the automobile industry is passing through is probably one of great benefit to the industry itself and to the commercial and industrial interests of the nation at large. From now on that industry will occupy a definite stabilized position with the rest of the metal-working industries. It will be less subject to sudden fluctuations, its status will be more definitely determined, and it can look forward to a prosperous future.

* * *

INDUSTRIAL CONDITIONS IN FRANCE

From MACHINERY'S Special Correspondent

Paris, March 12, 1921

The general industrial situation in France is not marked by any appreciable improvement. Almost complete industrial inactivity continues. The manufacturers of raw material find but a small market for their products, and business in the metal-working field remains very quiet, except in the plants working on railroad equipment. One of the main causes is to be found in the coal situation. English and American coal is too expensive, and France has to depend almost entirely upon the coal imported from Germany. The blast furnaces and steel mills have greatly reduced their production, and many blast furnaces are not operating. In the machine building field, in general, manufacturers complain of lack of orders.

The French Machine Tool Trade

About a year ago a combination of French machine tool builders was formed. This includes practically all the firms that have been engaged in building machine tools either entirely or as a side line. At one of the meetings of the association the question of increasing the tariff on machine tools to the highest possible point was taken up, and vigorous protests were raised against orders being sent by the French railroads to foreign countries.

The nominal price of machine tools remains the same, although there is hardly any buying; but the few transactions that have taken place involve machines offered at reduced prices or on special terms. In the small tool field there has been a considerable reduction in price, due primarily to the reduction in the cost of high-speed steel. Present prices for small tools are about 30 to 40 per cent below the prices in 1920.

There is considerable activity among foreign firms establishing themselves in France. A Swedish ball bearing company—the N.K.A. Ball Bearing Co.—has just built a plant of considerable size in the vicinity of St. Quentin for the manufacture of ball bearings. Another Swedish machine tool manufacturer has established an agency in Paris, and a large German machine tool firm has established a German branch in Paris for selling large machine tools and pneumatic tools. Another German company has just been organized to start in France, under its own name, the building of a large factory for the manufacture of compressed air equipment. This firm will enter into direct competition with the Ingersoll-Rand Co. in France.

The Automobile Industry

The French automobile industry has suffered the same as this industry has everywhere else. The firm of Citroën still continues to manufacture automobiles, but has made a considerable reduction in price in order to dispose of its product. It has also organized a taxi company in Paris using its own cars. The Panhard firm is planning to manufacture a limited number of automobiles, while the Majola firm has gone out of business. Dietrich & Co. are making a new type of six-cylinder fifteen-horsepower automobile. They have also received an important order for railroad material so that their plant operates nearly at capacity. The Gnome & Rhone Motor Co. is at present increasing its capital, and in addition to building automobiles and motorcycles, will manufacture textile machinery and semi-Diesel engines.

Higher Tariffs Demanded

Leaders in the French Chamber of Deputies and Senate have stated that they will protect French manufacturers from the competition of countries where the exchange rates are depreciated as compared with French currency. M. Haudos, president of the Customs Commission, has declared that "we are more and more swamped by products manufactured in foreign countries and especially those of Germany. We must protect ourselves immediately from this danger." On the other hand, the government is reluctant to increase tariff duties without careful consideration except in some instances. The general political situation in France prevents the increase of tariff against friendly countries, as for example, Belgium, so that the main question is to find a method of protecting French industries mainly against the competition of Germany.

Labor Conditions

There is a general tendency toward reduction in wages; one automobile firm has announced a 10 per cent reduction, which will probably be increased to 20 per cent by the time this is published. The men at first refused to work at the new rate and left the factory, but took up work again after two days when told that the firm was unable to take them back at the old rates. The men returned against the advice of the president of the French Federation of Labor. The principal officers of the federation have advised the men not to work at a lower scale of wages, but it seems certain that the men are not going to follow this advice, being more interested in having a job at a reduced wage scale than in having no job at all.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Bath Micrometer Plug Gage

This internal micrometer gage is essentially an instrument to be used in quantity production. It enables a workman, in producing a hole, to know its exact size during the machining process, as well as the exact amount of stock removed per cut, and so permits him to finish the hole with the assurance that he is obtaining the desired size. Thus it is unnecessary for him to depend upon "Go" and "Not Go" gages, which indicate the size of a hole after it has been finished rather than during the operation.

THE accurate measurement of cylindrical holes in parts is made possible by the use of the micrometer plug gage here illustrated, which has four measuring jaws that are expanded radially by operating a screw, after the instrument has been inserted in a hole, until each jaw is brought into line contact with the wall of the hole, the exact diameter of the hole being read in ten-thousandths of an inch from graduations on the handle of the gage, which record the positions of the jaws. This instrument is a product of John Bath & Co., Inc., 8 Grafton St., Worcester, Mass., and is furnished with a master ring gage for determining the accuracy of the micrometer gage at all times. Provision is made for adjusting the micrometer gage to compensate for wear. The basic size of the gage illustrated is 2 inches, but measurements ranging from 1.950 to 2.020 inches may be made.

The four measuring jaws *A*, Fig. 1, are provided with true cylindrical contact surfaces, and are held in perfect alignment on the sliding member *B* by means of close-fitting dovetailed slots. These measuring jaws are expanded or contracted when this slide is moved back and forth through the operation of a screw, this being accomplished by turning the graduated end of the gage handle. A longitudinal movement of slide *B* of 0.005 inch increases or decreases the diameter across the measuring jaws 0.001 inch. It is claimed that, as the movable jaws fit tightly in the dovetailed grooves of the slide and are controlled by an accurate screw without backlash, an instrument is obtained which is as rigid as a solid plug. Thus when the gage is inserted in a hole and adjusted by turning the micrometer head, the jaws stop abruptly when they come in contact with the walls of the hole, owing to the fact that there is no resilience in the instrument. This rigidity is a fundamental requirement in well made measuring tools. It eliminates springiness of the parts, which is sometimes referred to as "feel" and which often gives rise to variations of from one to several ten-thousandths of an inch when external measurements are made by two different people.

An important feature in the construction of the micrometer gage is the arrangement for reading the size of a hole. The micrometer head has ten main graduations, spaced about ½ inch apart, each space representing a movement of the measuring jaws of 0.001 inch. These main graduations are subdivided ten times, each of the spaces representing a movement of 0.0001 inch. An additional scale consisting of seven graduations is provided on the shank of the gage handle, the

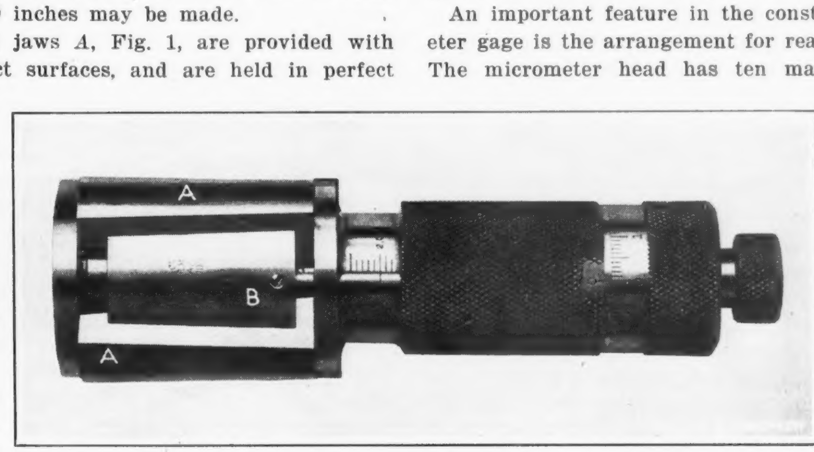


Fig. 1. Micrometer Plug Gage developed by John Bath & Co., Inc.

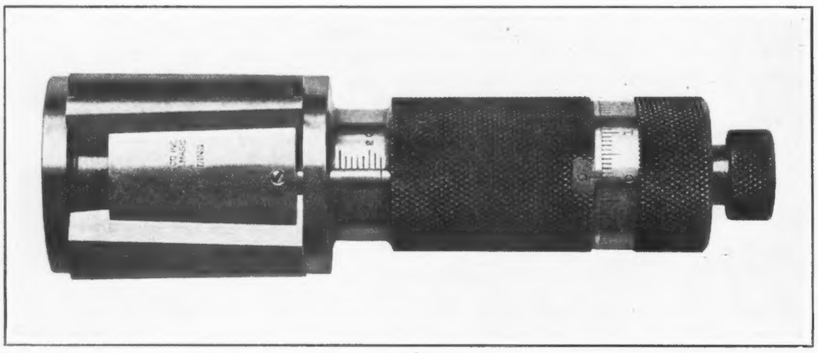


Fig. 2. Setting of the Micrometer Graduations when the Diameter across the Measuring Jaws is 2.020 Inches

distance between each of these graduations corresponding to the amount that the slide is advanced during a complete turn of the micrometer head, and during which an expansion or contraction of the micrometer jaws of 0.010 inch is made. This scale presents a means of indicating the amount that a reading is over or under the basic size of the gage. Thus in Fig. 2, the diameter across the jaws, as indicated by the reading on the handle, is 2.020 inches, and in Fig. 5 the diameter is 1.950 inches. A knurled thumb-screw on the handle end of the gage serves to clamp the micrometer head firmly, and thus permits a retaining of a setting or reading.

Provision is made to compensate for wear of the jaws. As shown at *A* in Fig. 3, this consists of a series of serrations on the outer end of the sleeve carrying the micrometer graduations and a similar series of serrations on the knurled member by means of which the gage screw is operated. By withdrawing the locking screw of this knurled member and moving sleeve *B* a distance of one serration, a jaw adjustment of 0.0001 inch is made. This adjustment is, of course,

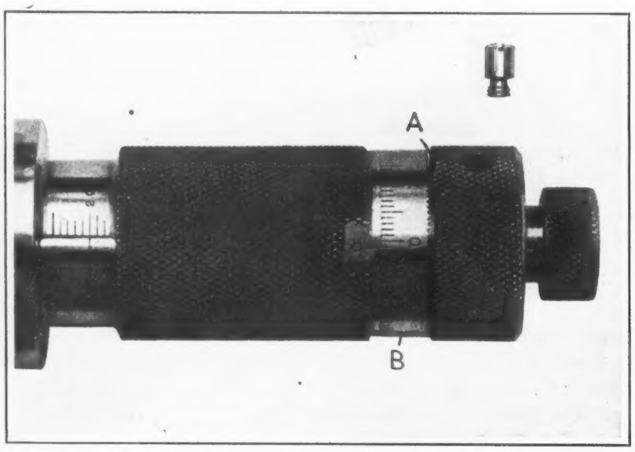


Fig. 3. Method of compensating for Wear of the Measuring Jaws

maintained when the knurled member is again advanced longitudinally and locked in place. By this means, any amount of adjustment up to 0.070 inch may be secured.

During the manufacture and inspection of the micrometer gage, it is compared by means of light wave measurement, with reference gages certified by the Bureau of Standards to be correct within a few millionths of an inch. The micrometer gage can therefore be adjusted so that when set at zero, the jaw diameter will be true within plus or minus twenty-five millionths inch. This limit represents variation from absolute size, and does not prevent the use of the gage in the inspection of ring gages or other internal cylindrical work to a greater degree of accuracy, as it is possible to detect errors as small as one hundred-thousandth inch.

After having been standardized by means of light waves, the internal micrometer gage is, in turn, used to verify a master reference gage, the latter being then preserved to serve as a standard by means of which the micrometer gage may at any time be adjusted and reset to the correct size, through the use of the adjusting arrangement previously explained. By reference to Fig. 4, it will be seen that the construction of this reference ring gage differs somewhat from the usual form. The deep wall section of the gage provides a great amount of rigidity, and the series of concentric holes, while having little effect on the strength of the ring, serves to reduce the weight materially; these holes also permit air circulation which causes the ring to return quickly to a normal temperature after being subjected to abnormal heat or cold.

Another fundamental feature of this reference gage is its narrowness. It is evident that a broad ring gage will pass

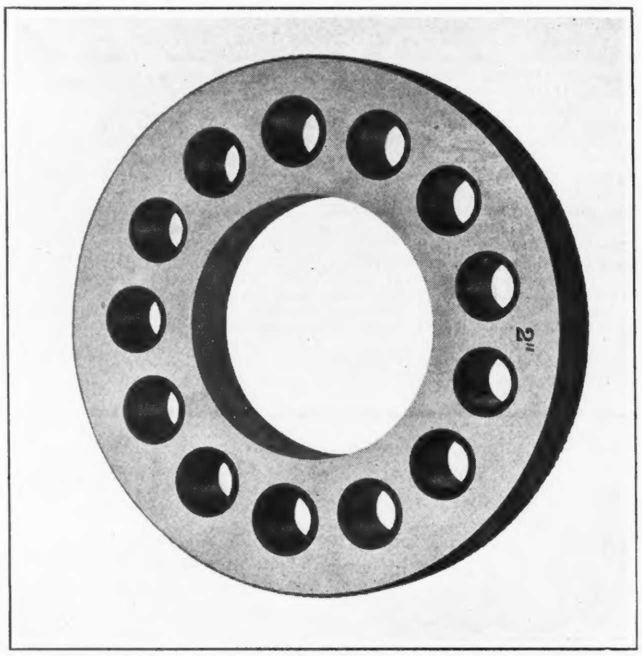


Fig. 4. Master Ring Gage for ascertaining the Accuracy of the Micrometer Gage

over surface depressions and make contact with only the high points of a plug being measured. However, a narrow ring serves to detect and locate any errors existing in the plug, and is thus better suited for use as a reference master gage. That there is little opportunity for wear to occur on the master ring gage when it is used solely as a standard for the micrometer gage may be realized from the fact that when inspecting the micrometer gage no sliding action takes place, because the jaws are expanded to come in contact with the internal surface of the ring.

The process of inspection by means of the micrometer gage is sufficiently simple to permit its use by an unskilled workman. In measuring a hole, if there is any indication that the hole is elliptical in shape, that is, if it is out of

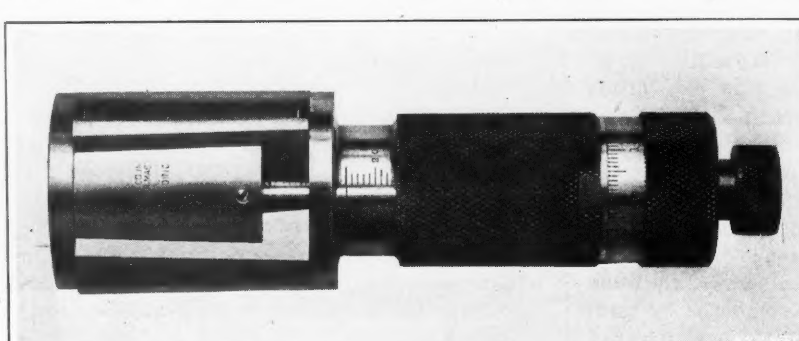


Fig. 5. Setting of the Micrometer Graduations when the Diameter across the Jaws is 1.950 Inches

round, the exact amount of error can easily be determined by rotating the gage a certain amount. By means of this gage it is possible to take measurements at different points in a hole, that is, at the front, at the center, or at the rear. This advantage permits any taper or bell-mouth to be readily discovered. The best way of measuring the diameter of a lapped internal cylindrical surface is to have the surfaces of both the part and the micrometer perfectly clean. They should first be washed with soap and warm water and then dried. The presence of lubricant simply serves to cover up or hide defects.

It is stated that great care has been given to the proportioning of all wearing parts of this micrometer gage to insure long life and accuracy. All movable parts are protected from grit and dust. An entire set of thirty-two gages will give continuous measurements by ten-thousandths from 7/8 inch to 3 inches.

UNIVERSAL PORTABLE CRANE

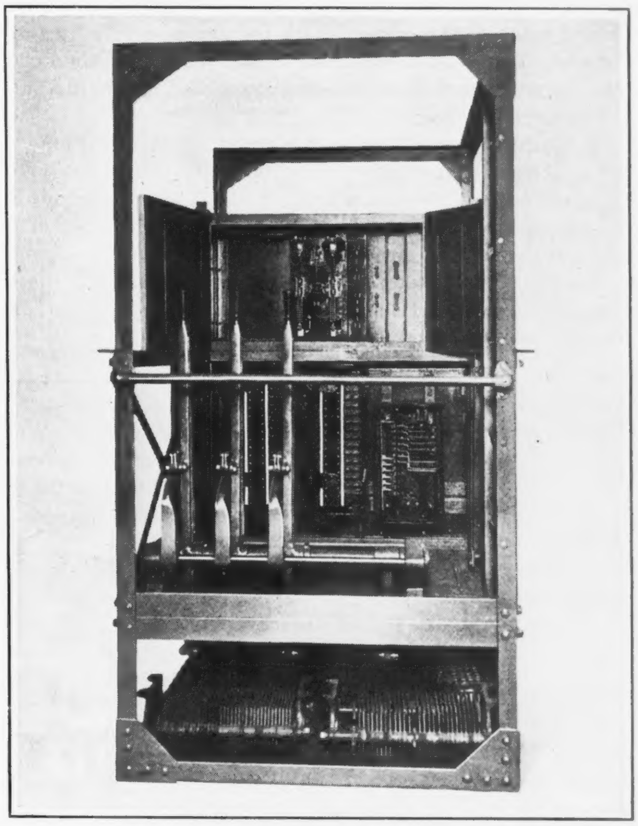
The portable crane shown in the accompanying illustration is mounted on a truck having steel wheels that permit the truck to be run on standard-gage railway tracks or on the ground. This truck is equipped with a driving mechanism for propelling it at a slow speed under its own power, and is controlled and steered from the operator's platform. The crane and truck complete are built by the Universal Crane Co., Swetland Bldg., Cleveland, Ohio. The current for the lifting magnet is supplied from an outside source, but the crane is so arranged that a generator driven by the crane motor could furnish the current. The crane capacity is from 3 to 4 tons, depending upon the counterweight, length of boom, mounting, and radius at which the crane works.

Self-propelling Crane made by the Universal Crane Co.

It is not necessary for the crane to be mounted on the truck shown, as it will operate equally well on a flat railroad car, an automobile truck, a trailer, or on a ground foundation. The crane may be driven by a 40-horsepower gasoline engine or by an electric motor of equal capacity. It has a full circle swing, and the length of the boom may be varied. The following equipment can be furnished with the crane: Grab bucket; electric magnet; hoist block; single, double or separately driven drum; and steam shovel.

PAWLING & HARNISCHFEGER CRANE CAB

The operator in the cab of a traveling crane usually has a limited amount of space in which to move about, and for this reason exposed knife switches, magnetic control parts, and resisters introduce a serious hazard. The cab illustrated has recently been placed on the market by the Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis., having been designed to insure maximum



Crane Cab made by the Pawling & Harnischfeger Co. in which the Entire Controller Equipment is enclosed in a Cabinet

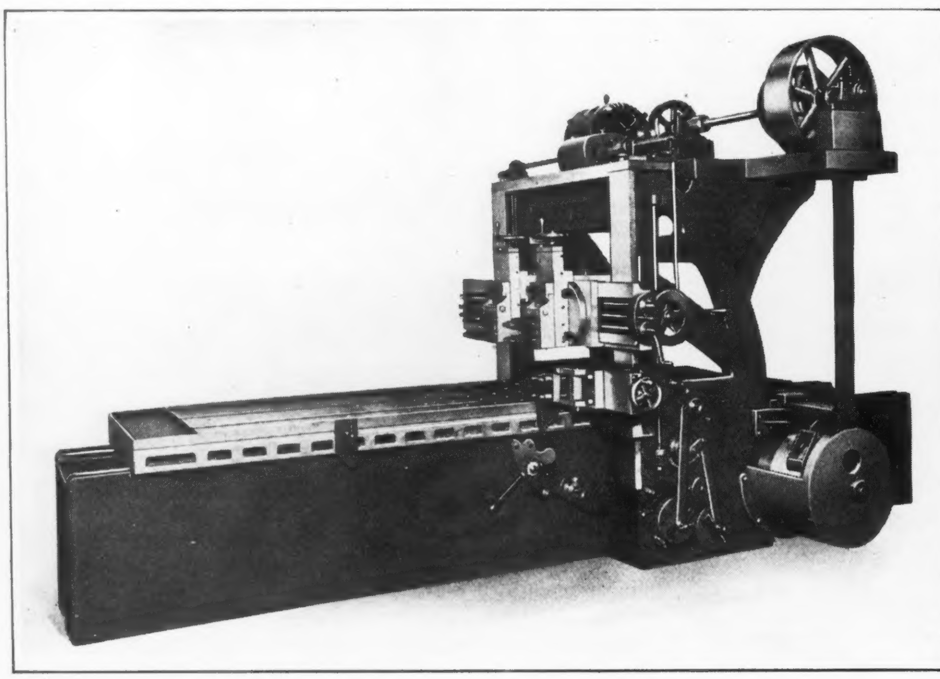
safety of the operator. As on previous crane cabs built by this concern, a false bottom is provided for the resisters, but there is also a front lever control, and the entire controller equipment and current-carrying parts are fully enclosed in a cabinet at the rear of the cab. The illustration shows the various cabinet doors open, but when they are closed all chance of the crane operator coming in contact with any live parts is entirely eliminated. The main knife switch is operated by a handle placed on the outside of one of the cabinet doors. Arrangement of the units in this manner makes unnecessary the usual controller covers. The wiring at the rear of the units is made accessible by removing a panel at the back of the cabinet. The control levers operate radially, and are placed at the front of the cab so as to allow the crane operator an unobstructed view of the shop.

WHITCOMB-BLAISDELL PLANER

The 32-inch planer shown in the accompanying illustration is a recent addition to the line of machine tools built by the Whitcomb-Blaisdell Machine Tool Co., 677 Cambridge St., Worcester, Mass. As on preceding machines of this type, the planer is provided with the company's patented second-belt drive, which permits the number of gears beneath the table to be relatively small, and reduces the jars and shocks produced by the reversal of the table. However, this planer differs from the smaller sizes in that it has a double gear reduction from the second-belt drive shaft to the table rack.

The compact construction of the machine will be apparent by reference to the illustration. The cross-rail is heavy and deep and has extra ribbing at the back to give sufficient stiffness. The table is braced with ribs at frequent intervals to guard against any possibility of springing. The table T-slots are planed from the solid metal, and the center T-slot extends the full length of the table beyond the chip pockets. Projecting ledges on the under side of the table prevent the dropping of chips into the ways. The housings are of the box type, bolted to the bed and rigidly connected at the top by a heavy rail. The bed is cast with a solid top, the only opening being at the center where the double gear reduction is placed. However, this opening is covered by a sheet-metal plate in such a way that only the upper segment of the bull gear projects through it.

The machine is equipped with a patented cross-rail binder that enables the operator to lock the cross-rail securely to the housings by operating a lever, without moving from his position on the working side of the machine. Patented self-locking shipper dogs are also a part of the regular equipment. It is only necessary for the operator to set these dogs for the required length of stroke. The principal dimensions of the machine are as follows: Actual width between housings, 36 inches; planing height under cross-rail, 32¾ inches; length of table, 10 feet; width of table, 28 inches; length of bed, 16 feet; length of down feed, 13 inches; and minimum distance between centers of tool-boxes, 7¼ inches. The approximate weight of the planer is 17,500 pounds.



Thirty-two-inch Planer built by the Whitcomb-Blaisdell Machine Tool Co.

FAFNIR BALL-BEARING LINE SHAFT BOX

The fact that the application of ball bearings in lineshaft boxes saves a great amount of power otherwise lost in transmission is no longer questionable. In installations of this kind the following points should be observed: The ball bearings must be located on a shaft that contains no shoulders; the inner rings of the ball bearings should be firmly seated on the shaft to avoid any possibility of tipping or slipping; provision must be made so that any deflection or misalignment of the shaft does not cramp the balls; the boxes should be designed in such a way that they can be installed as units without requiring delicate adjustments; and, finally, the ball-bearing boxes should be interchangeable with plain bearing boxes in standard hanger frames. With these points in mind, the Fafnir Bearing Co., New Britain, Conn., developed the bearing box illustrated in Fig. 1, which is provided with a transmission ball bearing at each end.

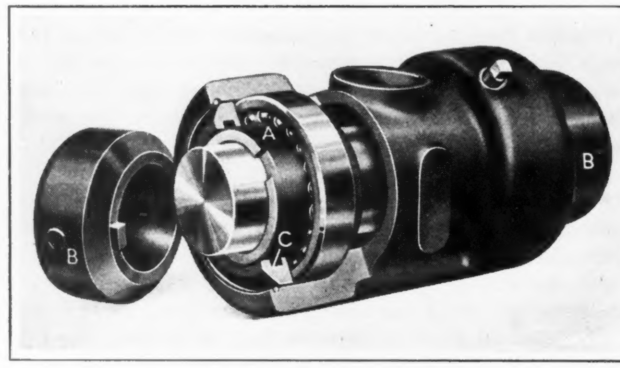


Fig. 1. Ball-bearing Lineshaft Box made by the Fafnir Bearing Co.

The principal feature of this box is the manner in which the ball bearings are mounted on the shaft. Each ball bearing is placed on a wide inner ring *A*, which is mounted directly on the shaft. Collar *B* is placed on the shaft in front of the ring in such a way that two lugs on the collar enter two slots on the front end of the ring, so that the latter is rotated with the collar. The collar is secured to the shaft by means of two hollow set-screws. A felt packing ring *C* is placed on the inner ring in front of the balls, and held in place through the medium of a retaining ring in an annular groove on the box casting. By this construction, the shaft, collar, and inner ring of the ball bearing revolve as one unit. The inner ring projects a sufficient distance beyond the packing ring to prevent the driving collar from coming in contact with the latter, and so all thrusts are delivered to the bearing.

It is permissible for the inner ring to be a slip fit on the shaft, and, in addition to this easy installation, other advantages of the wide inner ring are the amount of bearing afforded to the shaft, and the firm seating that the ring offers for the ball bearing. The purchaser receives the ball-

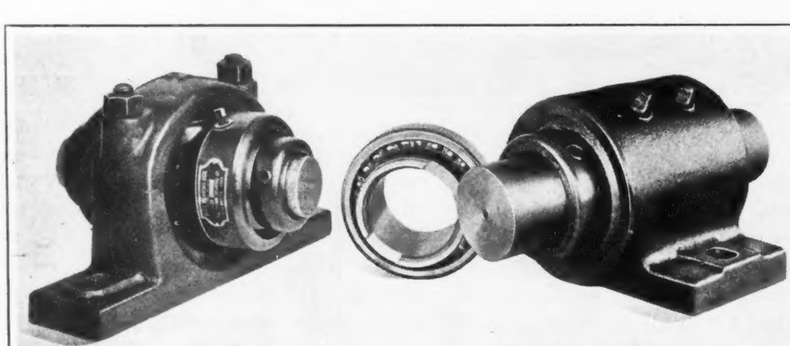
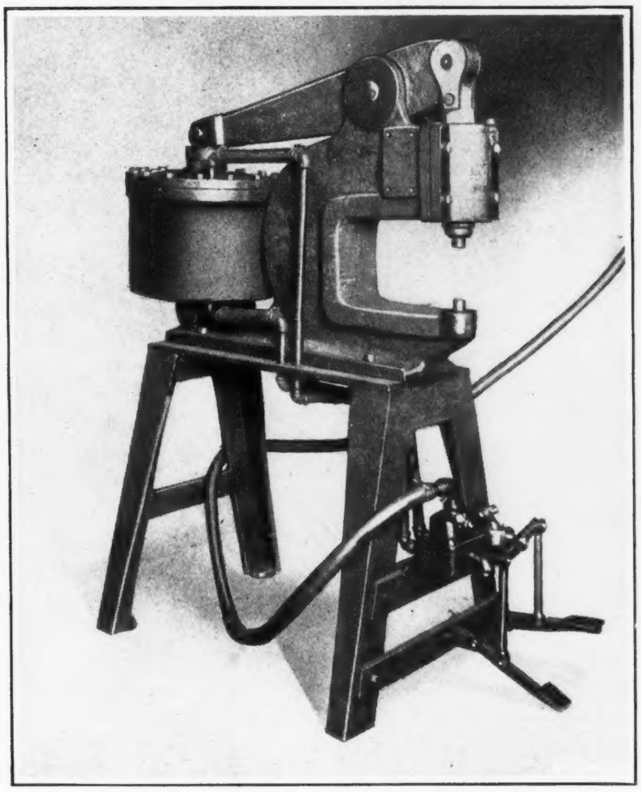


Fig. 2. Self-aligning and Rigid Pillow-blocks furnished Complete with Bearing Box

bearing box as a unit, ready for installation, and need only slip the box in place in a hanger frame or pillow-block, tighten the hanger screws in the ordinary manner, and tighten the screws of each driving collar on the shaft. Fig. 2, at the left, shows a box installed in a self-aligning pillow-block, and at the right, in a rigid pillow-block. Pillow-blocks of these types can be purchased complete with the ball-bearing box. Because of the interchangeability of this ball-bearing box with plain boxes in standard hangers, it is just as easy to install it in old shops as it is on shafting just being erected. It is only necessary to replenish the box with lubricant about once every six months.

BAIRD COMBINATION PUNCH AND RIVETER

The accompanying illustration shows a new punching and riveting machine developed by the Baird Pneumatic Tool Co., Kansas City, Mo. The frame of the machine is a one-piece casting having a split head. The air cylinder is of a single type, and is connected by means of a heavy lever to

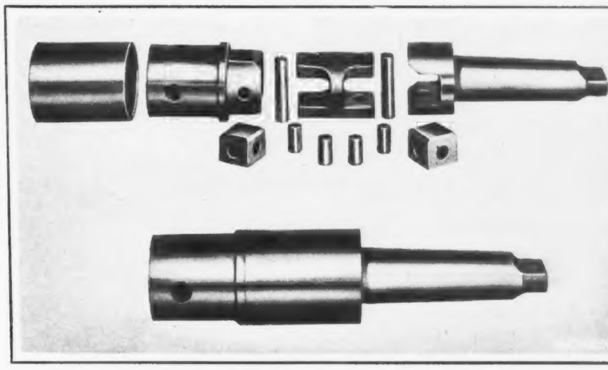


Combined Punching and Riveting Machine built by the Baird Pneumatic Tool Co.

the ram of the machine. By this arrangement a pressure of 70,000 pounds may be exerted on the riveting dies or punch. The machine is controlled by a foot-pedal valve, thus allowing the operator the use of both hands to direct work being punched or riveted. Two of the advantages claimed by the manufacturer for this machine are its high speed of operation, and the fact that two classes of machines are incorporated in one. The machine is capable of punching plates up to 5/8 inch in thickness, and of cold-riveting up to 3/8 inch in diameter. The machine and stand complete weighs approximately 650 pounds.

CINCINNATI UNIVERSAL-JOINT TOOL CHUCK

The Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, has recently developed the universal-joint tool chuck which is shown in the accompanying illustration before and after being assembled. The joint is full-floating, and has been incorporated in the construction to permit the



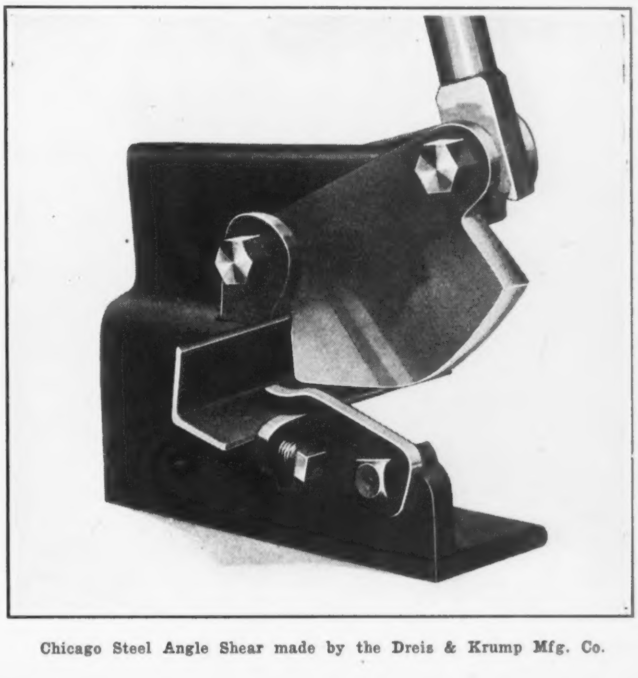
Disassembled and Assembled View of Universal-joint Chuck made by the Cincinnati Engineering Tool Co.

use of the chuck in connection with all types of boring and reaming fixtures requiring a table support for the tools. The use of the chuck eliminates errors on the work due to faulty alignment of the base or table of the machine on which an operation is to be performed, or of a fixture with the machine spindle. The universal joint is made comparatively short, in order to reduce the movable range of a machine spindle as little as possible.

This chuck is regularly made in three sizes, the shanks and holes in the socket ends being machined to Morse tapers; however, the chuck can also be furnished with any special style of shank or socket. The shank of the small regular size is No. 2 taper, while the socket may be either No. 1 or No. 2 taper, according to the wishes of the purchaser; the intermediate size may have either a No. 3 or No. 4 taper shank and either a No. 3 or No. 4 taper socket; and the large size of chuck has a No. 5 taper shank and a No. 5 taper socket. The various parts are made of alloy steel, hardened and ground.

DREIS & KRUMP STEEL ANGLE SHEAR

The steel angle shear illustrated is a product of the Dreis & Krump Mfg. Co., 2909-2923 S. Halsted St., Chicago, Ill., and has a capacity for shearing angle-irons up to 1½ by 1½ by 3/16 inch. The operating principle of the device is quite similar to that of the steel slitting shear described in the February number of MACHINERY. The frame and base are integral, being a pressed-steel piece. The shear blade is actuated by a geared lever, and is reversible having two cutting edges. It can be raised sufficiently to permit insertion of work from the front of the device. A clamping

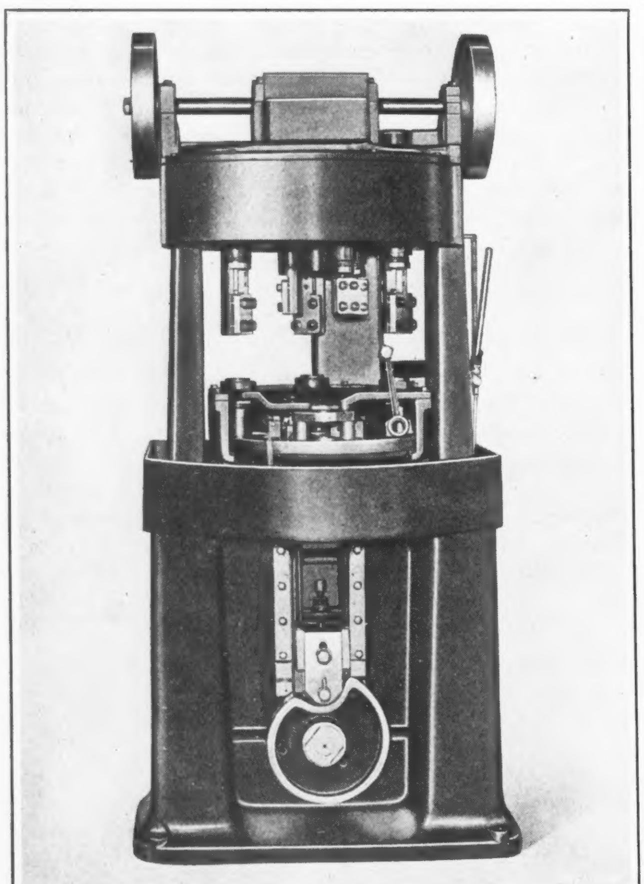


Chicago Steel Angle Shear made by the Dreis & Krump Mfg. Co.

arrangement prevents the work from shifting while being cut. The weight of the machine is 22 pounds; the length of the base, 9 inches; and the height of the frame, 8 inches.

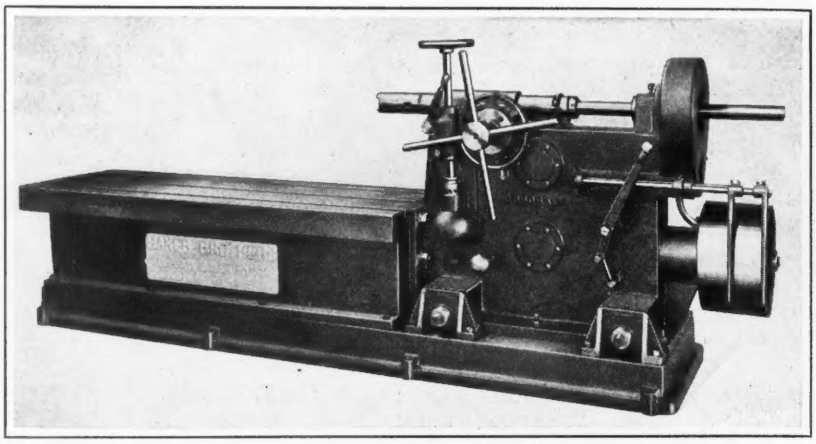
MULTIPLE-SPINDLE VERTICAL BORING MACHINE

A multiple-spindle vertical boring machine on which the spindles rotate but are held stationary vertically while an intermittent revolving work-holding table arranged for station boring is raised and lowered alternately to bring the work up to the cutting tools, has been recently placed on the market by the Manufacturers' Consulting Engineers, McCarthy Bldg., Syracuse, N. Y. The movement of the table is effected by a cam mechanism on the machine base, the cam permitting a variable feed and a quick return. The arrangement is such that as each successive station of the table reaches a certain position, no tool engages the work held in this station when the table is raised; this permits the piece to be removed and another substituted without stopping the machine.



Multiple-spindle Vertical Boring Machine made by the Manufacturers' Consulting Engineers

The machine is intended for a single purpose only; when it is desired to adapt it for machining different parts, it is necessary to change the head, the rotary table, and the cam. An idea of the capacity of the machine will be gained from the fact that in operating on connecting-rods, the large hole in which is 1 7/8 inches in diameter by 1 3/4 inches long, both the large and small holes are rough- and semi-finish-bored and reamed in 65 seconds. A similar machine rough- and semi-finish-bores and reams a 3 1/4-inch diameter cylinder, 9 inches deep, in 1 1/2 minutes. When the bottom of this bored hole is finished, one cylinder is completed in 1 minute 42 seconds. With larger machines of this type more than one piece of work can be finished per revolution of the table.



Horizontal Drilling and Boring Machine manufactured by Baker Bros.

BAKER HORIZONTAL DRILLING AND BORING MACHINE

The No. 217-H horizontal drilling and boring machine built by Baker Bros., Toledo, Ohio, which is shown in the accompanying illustration, was developed to meet quantity production needs, being particularly suitable for machining automobile crankcases, large transmission cases, rear-axle housings, etc. Fundamentally, the design of the machine is the same as that of the No. 217 vertical drilling machine manufactured by the same concern, including the annular ball-bearing drive. Practically any desired feed and speed of the spindle can be obtained through the use of change-gears. A vertical adjustment is provided to permit machining castings or forgings of different sizes.

The machine is capable of driving a 2-inch diameter high-speed drill in steel. The principal dimensions are as follows: Maximum height from table to spindle, 16 1/8 inches; minimum height, 15 3/8 inches; length of table, 75 inches; and length of feed, 16 inches. The weight of this machine is approximately 4750 pounds.

SHEPARD LATHES

The "Sterling" lathe manufactured by the Shepard Lathe Co., Rising Sun, Ind., is now being built with a completely enclosed geared head, and may be equipped for being driven by means of a single pulley countershaft, by a foot-treadle, or by a small electric motor mounted on the headstock and arranged for connection to an ordinary lamp socket without the provision of additional power, wiring, or control. A machine driven by the last-named method is illustrated in Fig. 1. The lathe may be furnished with either a plain or

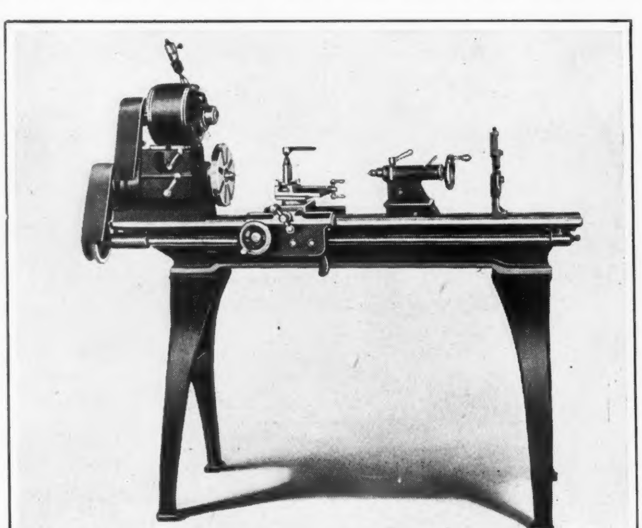


Fig. 1. Lathe built by the Shepard Lathe Co. for Garages, Training Schools, Light Manufacturing Work, etc.

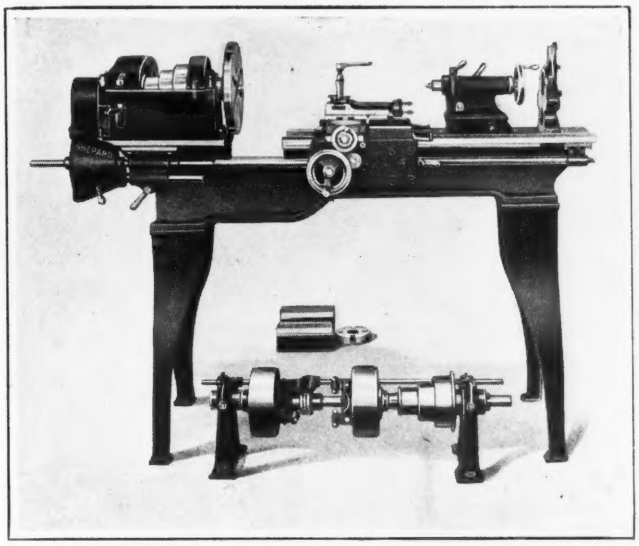


Fig. 2. Twelve-inch "New Shepard" Lathe now built in a Gap-bed Design

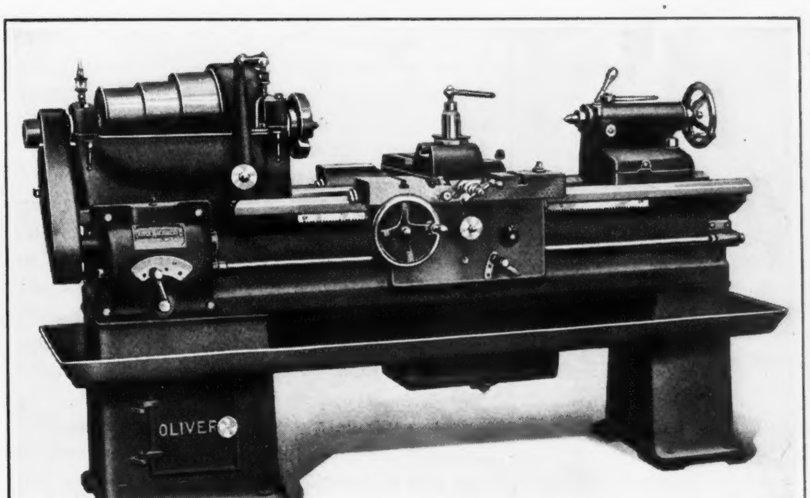
gap bed, and with standard or bench legs. The various types are especially suitable for use in garages, training schools, colleges, and repair shops, and for light manufacturing work.

The 12-inch "New Shepard" lathe made by the same concern is now also being made with a gap bed, as shown in Fig. 2. The swing of this machine is now 19 inches for a distance of 5 inches perpendicular to the front of the faceplate. The bed is designed to make it especially strong beneath the gap. The carriage is so constructed that there is no misalignment when it projects over the gap.

OLIVER 16-INCH RAPID-PRODUCTION LATHE

After having tried out the 16-inch rapid-production lathe here illustrated, in several automobile manufacturing plants, the Oliver Machinery Co., Grand Rapids, Mich., is placing it on the general market. This machine might be considered as a 16-inch heavy-duty engine lathe, except that all parts not of use in the quantity production of work likely to be handled on the machine, have been eliminated. In the illustration the lathe is shown equipped with a three-step cone pulley having large diameters and wide steps, this combination permitting a powerful drive at comparatively high speeds.

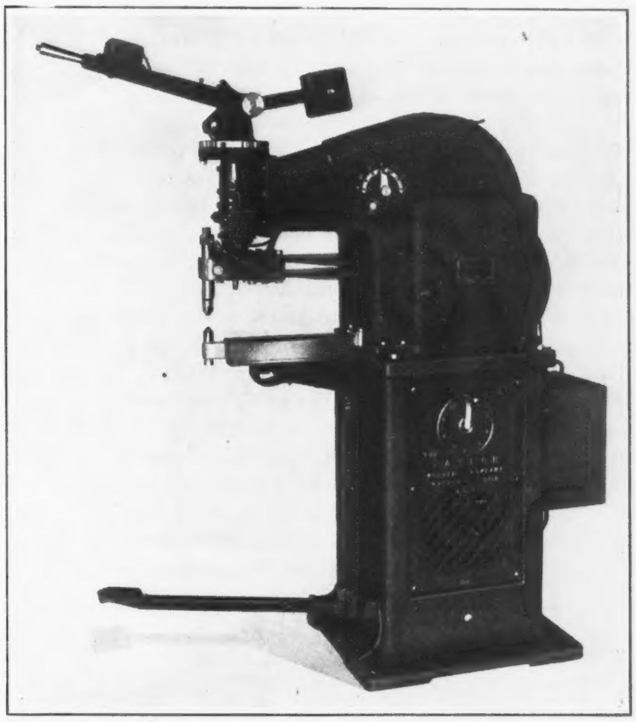
One of the features of the machine which permits a high rate of production is the operation of the starting and stopping clutch through the medium of the lever at the front of the headstock. The lathe may also be furnished with a headstock having double or single back-gears. Four speeds are obtained through the quick-change gear-box. It will be noticed that the toolpost construction on this machine is unusually massive to provide for taking heavy cuts. Provision is also made for supplying a continuous flow of cutting compound to the work.



Rapid-production Lathe built by the Oliver Machinery Co.

TAYLOR SPOT-WELDING MACHINE

The Taylor Welder Co., Warren, Ohio, has recently introduced the improved type of spot-welding machine here illustrated. One of the new features of this machine is that the head has square slides and steel caps instead of the round spindle construction employed on preceding types. This new design permits any looseness of the parts due to wear to be readily compensated for. The machine may be operated either by the hand-lever at the top, or by means of the foot-treadle. The hand-lever can be swiveled 90 degrees on each side of the center, and locked in any position between these points by means of a screw. It is unnecessary to make any disconnections when changing from hand-lever to foot-treadle operation, the hand-lever remaining in the upper position when the machine is being operated through the use of the foot-treadle. The height of the hand-lever can be changed to suit the operator, and the travel of the lever and that of the foot-treadle can be regulated by means of the lever shown on the right side of the overhanging arm. The foot-treadle may be swiveled to the right or left, and may be removed when not in use. Pressure on the work may be altered by means of an adjusting screw in the center of the upper electrode-holder.



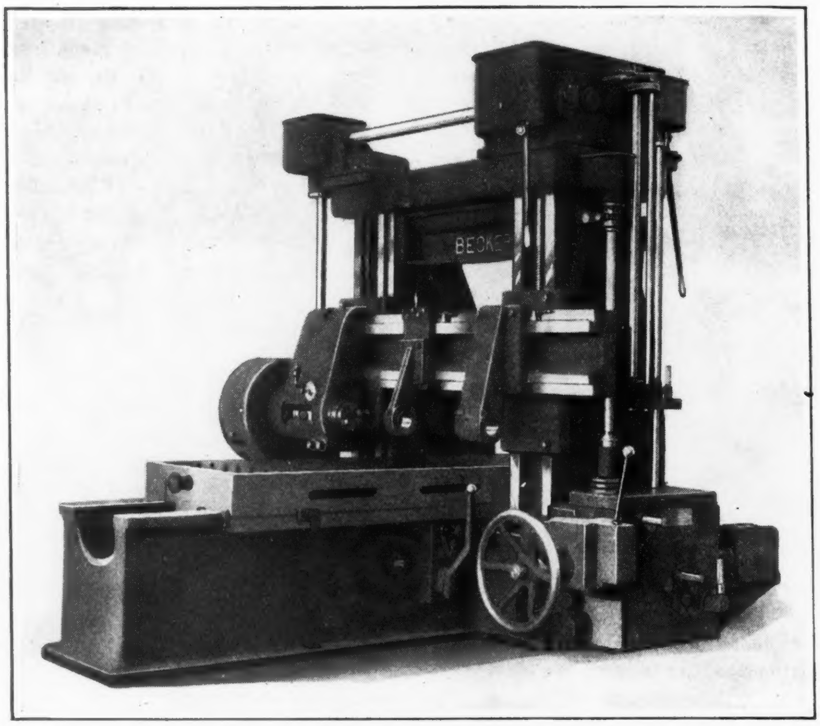
Spot-welding Machine built by the Taylor Welder Co.

Either an automatic or non-automatic switch may be used. When using the automatic switch, the electrodes are brought under spring pressure in contact with the work; then a further movement of the hand-lever or foot-treadle turns on the current and the work is immediately heated to a welding temperature. A further movement of the hand-lever

or foot-treadle cuts off the current, causes a positive pressure to be applied to the metal, and completes the welding operation. The non-automatic switch is operated by a button in the end of the hand-lever, the electrodes being brought into contact with the work under positive pressure, permitting the operator to apply heavy pressure before and after the current is turned on and off. Additional pressure may also be applied by means of the foot-treadle. This machine is capable of welding two pieces of sheet steel from 1/64 to 1/4 inch thick or of corresponding gages.

BECKER PLANER-TYPE MILLING MACHINE

A line of planer-type milling machines of the design illustrated is being built by the Becker Milling Machine Co., 677 Cambridge St., Worcester, Mass., in widths ranging from 24 to 48 inches, and in lengths up to 20 feet. These machines are of heavy construction and are driven through a single-pulley gear-box mounted on top of one of the housings. A clutch furnished on the driving pulley for starting and stopping the machine is operated by means of a lever conveniently placed on the operating side. On motor-driven machines, a similar arrangement eliminates the necessity of stopping and starting the motor in order to stop the machine.



Planer-type Milling Machine built by the Becker Milling Machine Co.

Hardened steel gears of the automobile transmission type are furnished, and these run in oil. Speed changes are obtained by operating levers located on the side of the right-hand housing. The drive to the spindle is through a bronze worm-wheel and a steel worm running in oil. The bed and table are of the box type and heavily constructed to insure rigidity. The table is driven by a spiral worm directly connected to the table rack, this worm also running in oil. The milling head has a hand and power traverse on the rail. The rail is counterweighted and is elevated by power, a fine hand adjustment being provided. This type of machine may also be furnished with two vertical milling heads.

GLEASON 8-INCH SPIRAL BEVEL GEAR GENERATOR

A new size of spiral bevel gear generating machine manufactured by the Gleason Works, Rochester, N. Y., is shown in the accompanying illustrations. The principle on which this machine operates represents no departure from that of the larger spiral bevel gear generator made by this concern, which was described in the April, 1914, number of MACHINERY. The older machine has been used principally in the production of automobile rear-axle driving gears. Several improvements in design and some new features have been incorporated in the new generator in order to meet the requirements of fast production on smaller size gears. The machine is particularly adapted for cutting automobile overhead camshaft driving gears, for which there is a constantly increasing demand. It has a capacity for cutting spiral bevel gears up to 10 1/8 inches in pitch diameter for an 8 to 1 ratio, and gears up to 7 1/4 inches in pitch diameter for a 1 to 1 ratio. The largest pitch for which the machine is adapted is limited only by the depth of cut, and corresponds to that of a 4 diametral pitch gear.

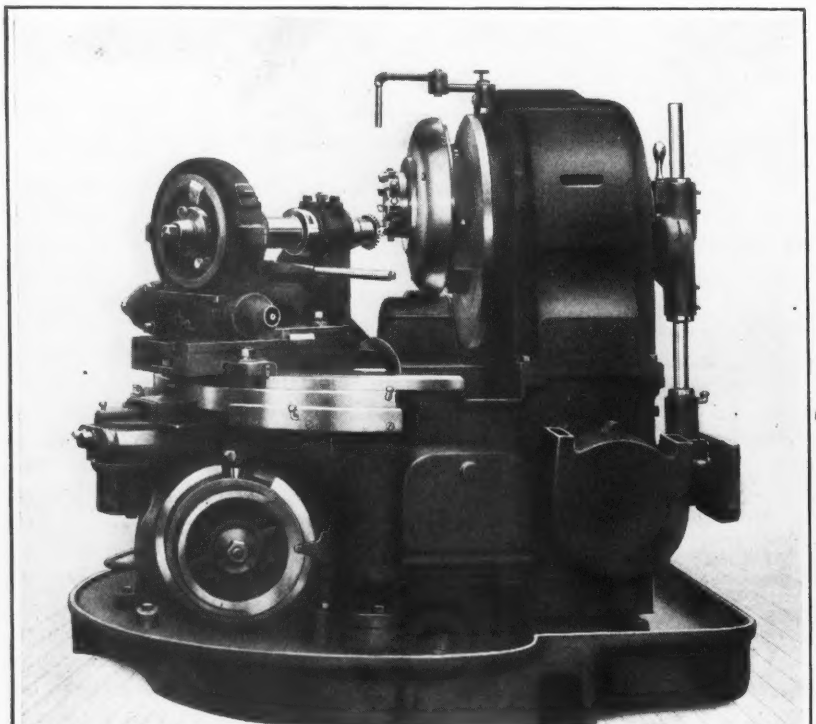


Fig. 1. Eight-inch Spiral Bevel Gear Generator manufactured by the Gleason Works

Two different sizes of cutter-heads can be used on the machine: A 9-inch diameter cutter with sixteen blades, and a 6-inch diameter cutter having twelve blades. There are six speeds for each size of cutter, ranging from 52 to 200 feet per minute for the 9-inch cutter, and from 35 to 133 feet per minute for the 6-inch cutter. The cutter-spindle *A*, Fig. 2, is driven by the internal gear *B*, which is mounted between the cutter and the front spindle bearing. This construction relieves the spindle of all torsional strains. The spindle bearings are mounted eccentrically in a drum which can also be turned eccentrically in the generating plate *C*, with respect to the

center of the machine. The different radial settings of the cutter are obtained by turning this drum in the generating plate. A positive stop has been provided for use when changing the cutter setting from the top to the bottom setting of the tooth. This provision eliminates the necessity of reading graduations every time a cutter setting is changed.

The cam which swings the gear blank in and out of contact with the cutter is designed in such a way that the blank is withdrawn slightly from the cutter at the beginning and end of the cutting roll, so that the difference of the backlash in the gear trains connecting the cutter- and the work-holding lubricating oil, and another of 8-gallon capacity for cutting oil. The lubricating oil is pumped to a reservoir on top of the cutter-spindle housing, from which it is distributed by gravity to the various bearings to be oiled. This machine is a complete unit, on which gears can be both roughed and finished. However, when a battery of machines is in use, it is the general practice to use this type of machine for finishing only, the gears being first roughed out on a less expensive spiral bevel gear roughing machine. The weight of the machine is 5500 pounds, and the floor space occupied, 48 by 65 inches.

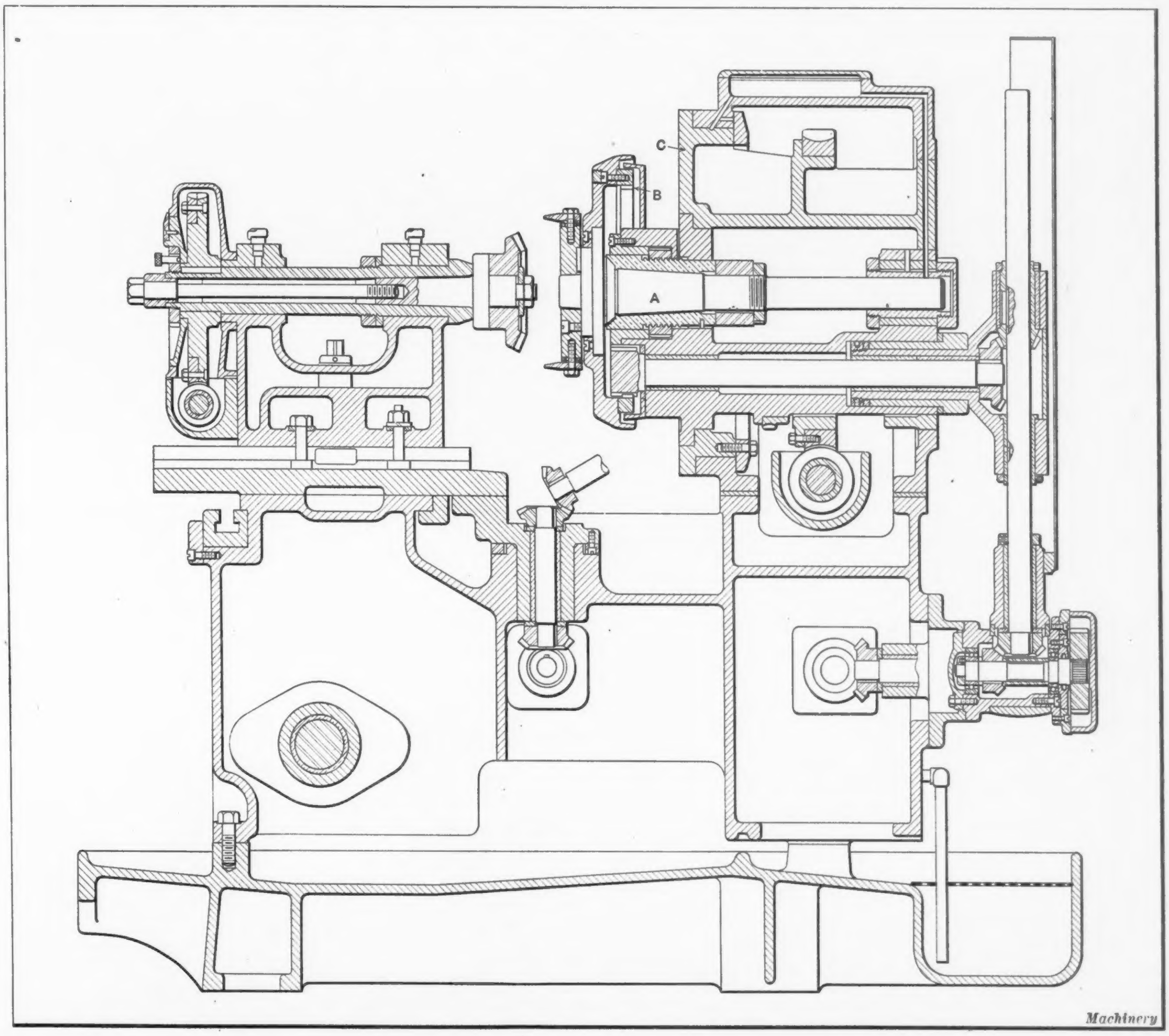


Fig. 2. Cross-sectional View of Gleason Spiral Bevel Gear Generator, showing Manner of Driving

rolls with the reversing mechanism does not cause the cutter to cut into the blank at the time that the rolling motions are reversed. By this withdrawal of the gear blank at the beginning and end of the cutting roll, the actual generating roll required is considerably shortened. The speed of the cam varies during one complete cycle. The feed change-gears control the actual cutting time only, while the time consumed in withdrawing the blank from the cutter, in indexing, and in returning the work to the cutting position, is constant and less than five seconds. If the time in which a tooth is actually cut is doubled, then the time it takes for one complete cycle of the feed-cam will be increased only by the increase in the actual cutting time. There are fourteen feed changes on the machine, ranging from 5 to 43 seconds actual cutting time per tooth, or from 10 to 48 seconds total cutting time.

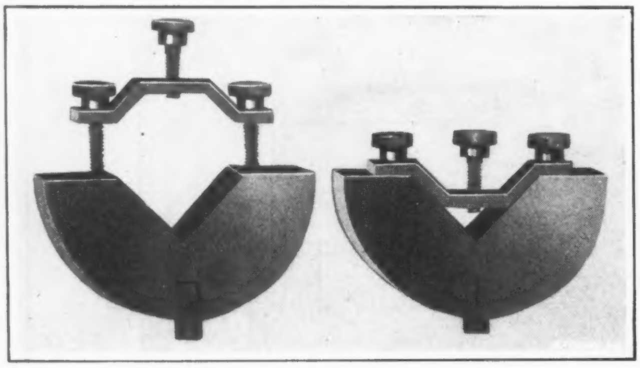
The oil-pan has two sumps, one of a 6-gallon capacity for

PRECISION GAGE-BLOCK FOR THREAD LEAD VARIATOR

A lathe attachment designed by the Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., for increasing or decreasing the normal lead of the lead-screw and for correcting any error in this lead, was described in the March number of MACHINERY. The accompanying illustration shows a gage-block designed to facilitate the setting of this lead variator. This gage-block is clamped directly on the work, and can be used on work up to 3 inches in diameter. At the left in the illustration the device is shown with the clamping member in position for large-diameter work, while at the right it is shown arranged for work of small diameter.

The projection at the bottom of the gage-block is exactly 1 inch wide. The method of using the gage-block is as

follows: A dial indicator is mounted on the toolpost of the lathe, and a reading is taken on the right side of the projection on the under side of the gage-block, the latter being mounted on the work as previously explained. The cross-slide is then operated until the indicator has been withdrawn to clear the gage-block, after which the lathe spindle is revolved as many times as there are threads to the inch on the work. The scribed line seen on the gage-block at the right indicates complete revolutions of the spindle. After the spindle has been revolved as described, a reading is taken by the indicator against the left side of the projection



Gage-block used in setting Lead Variator made by the Precision & Thread Grinder Mfg. Co.

on the gage-block, the dial indicator having traveled exactly 1 inch, provided the lead of the lead-screw is correct, which can be determined by means of the dial indicator. In cases where it is desired to obtain a precise lead, the rack of the variator is tilted up or down as necessary until the dial indicator gives the same reading on both sides of the gage-block projection.

BROWN SPRING COUPLING

A flexible spring coupling known as the "Kanti-lever" has been developed by the Brown Engineering Co., 133 N. 3rd St., Reading, Pa., for use as a connection on such equipment as dynamos, motors, steam turbines, lineshafting, and air compressors. This coupling is of all-metal construction and not only corrects angular and parallel misalignment, but also serves as a shock-absorber by transforming suddenly applied loads into gradually applied loads. This function reduces stresses imposed on shafting, gear teeth, keyways, and other details of a power transmission mechanism. The driving action of the coupling is effected by means of twelve laminated springs *A*, Fig. 2, which are held only at the inner ends. By this construction the springs have a freedom of movement, and there is a low fiber stress when the driving member of the coupling revolves and the driven member is rotated by the springs.

Reference to Fig. 2 will show that the arrangement of the springs permits the coupling to be rotated in either direction about its axis. The laminations of a spring unit are each provided with a notch into which the circular retaining ring *B* fits, the latter being held in place by means of screws. When it is necessary to replace one of the spring units, the retaining ring can be withdrawn from the notches after the screws have been removed, and any spring unit can be ejected by tapping with a light hammer.

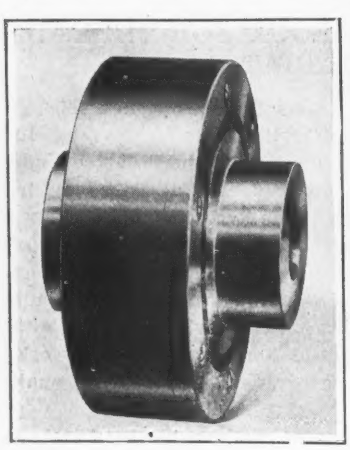


Fig. 1. Brown Flexible Coupling

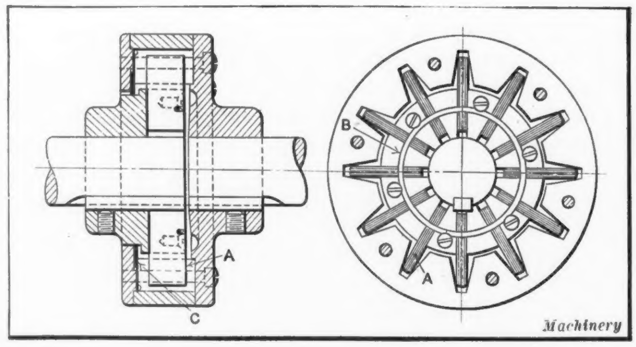
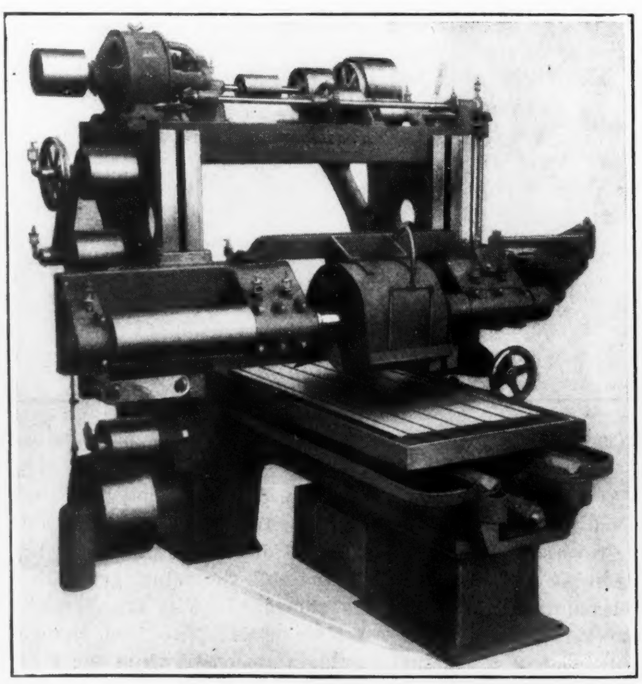


Fig. 2. Cross-sectional View of Brown Flexible Coupling, showing Laminated Driving Springs

The coupling is designed to correct angular misalignment up to 5 degrees. When two shafts are parallel but not absolutely on the same level, the coupling compensates for the error and relieves shafts and bearings from strains caused by such a condition. In instances of this sort, the smaller sizes of the coupling take care of a shaft offset of 1/16 inch, while the larger sizes compensate for an error of 3/16 inch. It will be noted that the coupling is entirely enclosed to permit the members to run constantly in a lubricant. The floating grease ring *C* prevents the lubricant from leaking. The coupling is made in eighteen sizes, the smallest of which is capable of transmitting up to ½ horsepower and may have a bore diameter of 11/16 inch, while the largest transmits 1000 horsepower and may have a bore diameter of 10 inches.

SPRINGFIELD OSCILLATING SURFACE GRINDER

A heavy-duty self-contained motor-driven oscillating surface grinder of new design has been added to the line of products of the Springfield Mfg. Co., Bridgeport, Conn. By



Heavy-duty Surface Grinder built by the Springfield Mfg. Co.

reference to the illustration it will be noted that this machine is of heavy and substantial construction. It is provided with two wheels, 20 inches in diameter and 6½ inches wide, mounted on a spindle 3½ inches in diameter. The wheel-spindle is supported in bearings 18 inches long. One of the principal features of this machine is the direct motor drive to the oscillating spindle. This drive is made possible through the provision of a drum pulley on the left end of

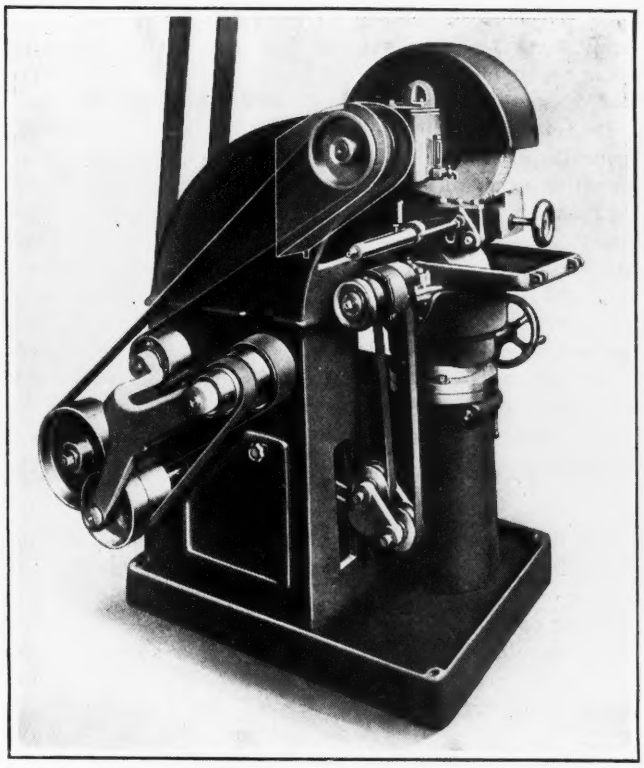


Fig. 1. Heavy-duty Centerless Grinder made by the Detroit Machine Tool Co.

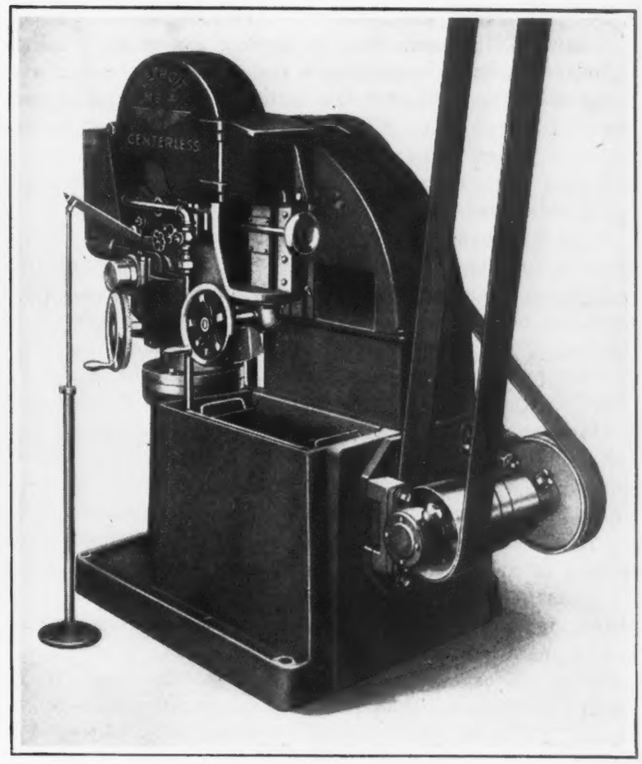


Fig. 2. Operating Side of the Detroit Heavy-duty Centerless Grinding Machine

the spindle, and by preventing the belt from moving sidewise with this pulley as the latter moves to and fro with the spindle. The entire grinding unit is oscillated by means of a crank attached to the right end of the cross-rail. This machine has a capacity for grinding work up to 5 feet in length, 30 inches in width, and 18 inches in height. Work up to 52 inches in width can be passed between the uprights. The weight of the machine is about 15,650 pounds.

DETROIT HEAVY-DUTY CENTERLESS GRINDING MACHINE

A new type of heavy-duty centerless grinding machine has lately been placed on the market by the Detroit Machine Tool Co., 6545 St. Antoine St., Detroit, Mich. A view of the left side of this machine from the front is shown in Fig. 1, while Fig. 2 shows a view of the right side from the rear. On this machine the work is placed between two revolving emery wheels, the lower of which causes the work to be rotated and fed past the upper or grinding wheel. The feeding movement of the work is accomplished by having the driving wheel swung around on the column supporting the wheel housing so that its axis is at an angle to that of the grinding wheel, the result being that the work is moved endwise at the same time that it rotates. This action should be clearly understood by reference to Fig. 3, in which the work is shown being fed between guide blocks. These blocks are adjusted by means of long screws actuated by handwheels. By changing the angle of the wheel from 0 to 6 degrees, the work is moved endwise at speeds ranging from 0 to 100 inches per minute. Thus it is possible to set the wheel at an angle that will cause work to be fed at the same feeds as on standard grinding machines.

Since the work lies on top of the driving wheel, it rotates whether it is being ground or not. If work varies in diameter, only those pieces that exceed the distance between the driving and grinding wheels will be ground. This feature permits an operator, when sizing pieces of cold-rolled steel, to tell at a glance which pieces are under size. The driving

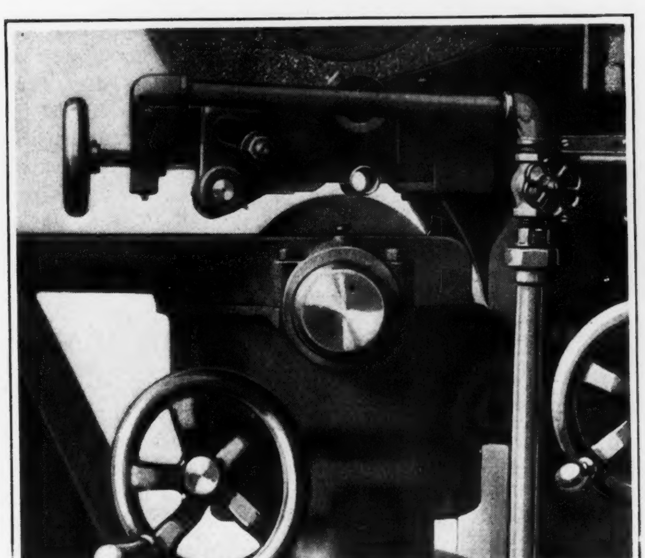


Fig. 3. Work being fed by Driving Wheel through Guide Blocks

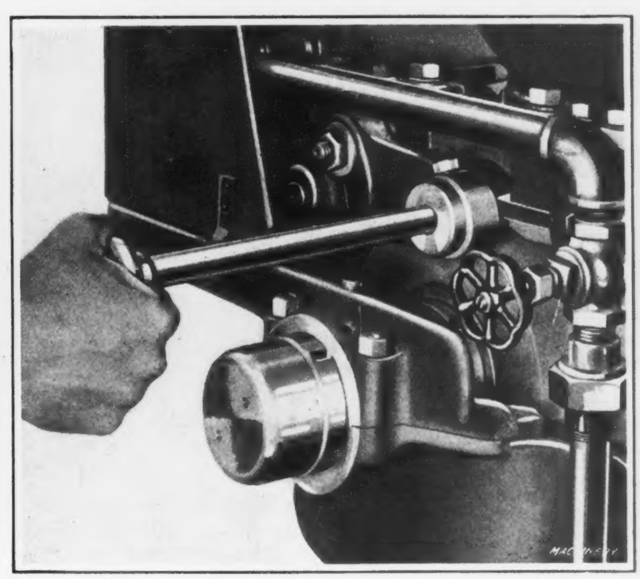


Fig. 4. Method of using the Diamond Wheel-truing Device

wheel is 8 inches wide, while the grinding wheel is only 4 inches wide, this arrangement causing the work to rotate before it comes in contact with the grinding wheel, and to continue to revolve after the grinding operation has been completed, thus being automatically drawn away from the grinding wheel. There is never any danger of one piece being fed faster than the piece ahead of it, a condition which would cause a disturbance resulting in chatter marks.

Work less than 4 inches in length can be fed into the machine by arranging the pieces in a row in the angle-iron feed trough seen in Fig. 2, this trough being set at an angle from the horizontal so that the work slides by gravity to the top of the driving wheel where it is caused to rotate and fed forward. This method of feeding keeps the pieces close together, so that the grinding wheel is constantly working along its entire width. The operator can place a sufficient number of pieces in the trough to give him enough time to inspect completed work coming through the opposite side of the machine. As the grinding wheel becomes worn the lower wheel column can be raised without stopping the feeding or grinding of work. Long pieces of work are fed through the machine one after the other, and when completed they roll through an opening in the frame and return to the operating side of the machine.

The depth of cut possible on this machine varies from 0.0001 to 1/64 inch, depending upon whether the work is soft or hardened. A high-grade finish can be obtained on work by increasing its speed of rotation. Roughing wheels can be placed on the machine and removed in five minutes. A special wheel-truing device with or without a diamond is furnished with each machine. This device is used by inserting it between the guide blocks and drawing it back and forth in the direction indicated in Fig. 4, which shows the hand of the operator holding one end of the device. The grinding wheel is driven by a 4-inch belt from a countershaft at the rear of the machine, while the driving wheel is driven through a small gear-box.

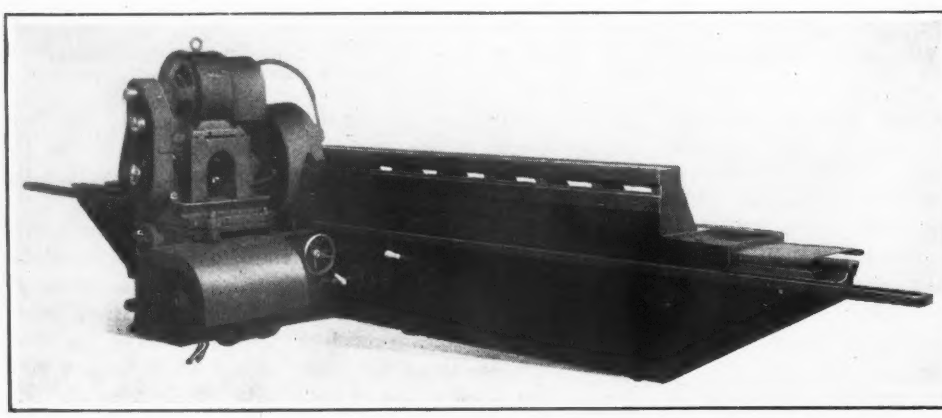
A generous bearing is provided for the grinding wheel spindle, phosphor-bronze boxes of the take-up type being fitted into adapters in the machine frame. Between these boxes is a large reservoir holding four quarts of oil, and in this reservoir are located the nuts that take care of the end thrust and take-up of the bearings. The driving wheel bearings are also phosphor-bronze boxes in cast-iron adapter sleeves of standard design. The spindle of this wheel seldom runs faster than about 50 revolutions per minute except when it is being trued with a diamond, at which time it runs about 1000 revolutions per minute.

A safety feature installed in the cylindrical extension of the lower wheel bearing, which can be seen in Fig. 1, consists of a clutch that is operated by pulling a handwheel endwise. An outward motion will cause the wheel to revolve at the proper work-rotating speed, while an extreme inward push will disengage a back-gear. The wheel will then rotate at a high speed for wheel-truing purposes. If work too large in diameter is presented to the machine by mistake, the moment the operator notices the heavy cut being taken he can push the handwheel toward the wheel and cause the latter to stop revolving instantly.

In grinding piston-pins 1¼ inches in diameter and 4 inches long, 180 pieces were finished per hour. On another operation consisting of sizing cold-rolled steel pins ⅜ inch in diameter by ⅞ inch long, 5140 pieces were ground per hour. It is stated that scratches or flat surfaces are not produced on the work while it is being ground, because it is constantly rotating. The capacity of the machine is for work from ¼ to 3 inches in diameter, and from ¼ to 16 inches in length. Brass rod and tubing have been ground in lengths up to 3 feet, supports being employed to hold the work in alignment.

SPRINGFIELD SHEAR BLADE AND FACE GRINDER

The heavy-duty reversing motor grinding machine illustrated is a recent development of the Springfield Mfg. Co., Bridgeport, Conn., and may be used for shear blade and face grinding operations. This machine is entirely self-contained being operated by three motors, one of 15 horsepower for driving the grinding wheel, another variable-speed 5-horsepower reversing motor for driving the table traversing mechanism, and a ½-horsepower motor for driving the pump. The variable-speed motor moves the table at different speeds ranging from 7 to 27 feet per minute, while the reversing feature of the motor dispenses with all belting. The operation of the machine is controlled by mechanical means from either the front or rear, and a push-button is provided for controlling the motors. This machine can also be furnished with a swivel knife-bar for grinding large paper and veneer knives, and by removing the work-holding angle-bar shown on the table it can be used for all kinds of face grinding operations within its capacity.

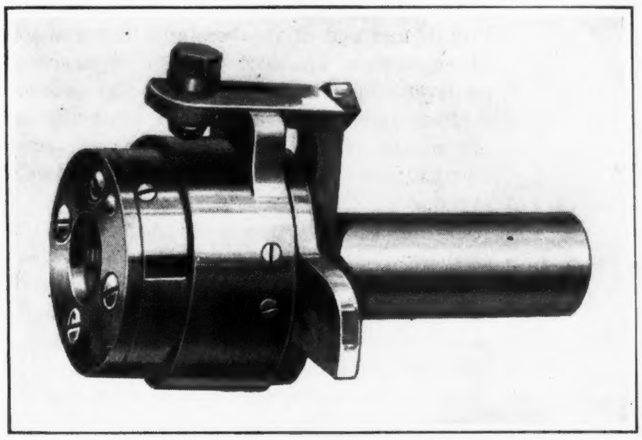


Shear Blade and Face Grinder with Reversing Motor, made by the Springfield Mfg. Co.

In the construction of this machine a modern design of bearing known as the "sleeve flange" type has been introduced. The bearings fit into bored holes and are bolted in place by means of flanges. These flanges are bronze-bushed, and can easily be replaced in case of wear without disturbing the original alignment. The machine as shown is arranged for wet grinding, and ample provision has been made to take care of spray and drainage. The wheel-head can be swiveled by means of a rack and pinion seen at the rear of the machine in the illustration, so as to permit the grinding of concave surfaces when desired. The machine has a grinding wheel 24 inches in diameter, and has a capacity for work up to 12 feet in length; however, it is also made in various lengths from 6 to 17 feet. The weight of the 12-foot machine is approximately 14,750 pounds.

EASTERN SELF-OPENING DIE-HEAD

The Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn., has recently made an improvement on the H & G self-opening die-head for use on Brown & Sharpe automatic screw machines. The illustration will suffice to show that changes have been made in the driving method and in the design of the trip-lever. On the previous type, the head was kept from turning in the floating shank by means of a pin through the shank proper engaging and

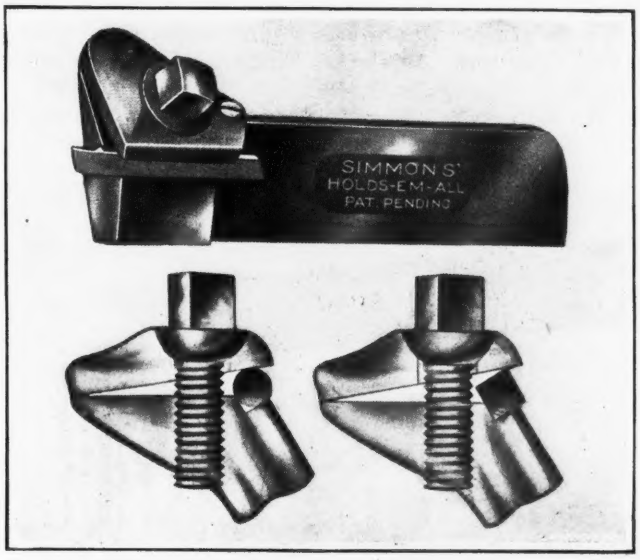


Improved Type of H & G Die-head made by the Eastern Machine Screw Corporation

traveling in diametrically opposite slots in the floating shank. As redesigned, the same result is obtained by an extension on the shell of the head which engages both sides of the arm of the floating shank that overhangs the body. This construction brings the drive farther from the axis of the die-head and decreases the friction to a negligible quantity, so that even a part to have the coarsest pitch that a machine will pull may be threaded without friction or cramp in the die-head. The design of the trip-lever has been changed to make the lever sensitive to the finest of threads up to about 90 per inch. It is a simple matter to install this head on any Brown & Sharpe automatic screw machine, practically no change being necessary.

SIMMONS TOOL-HOLDER

A new type of tool-holder known as the "Holds-em-all," which permits the use of very short bits, has recently been designed by the Simmons Economy Tool Corporation, 981 Broadway, Albany, N. Y., and is shown in the accompanying illustration. The holder is provided with a long shank,

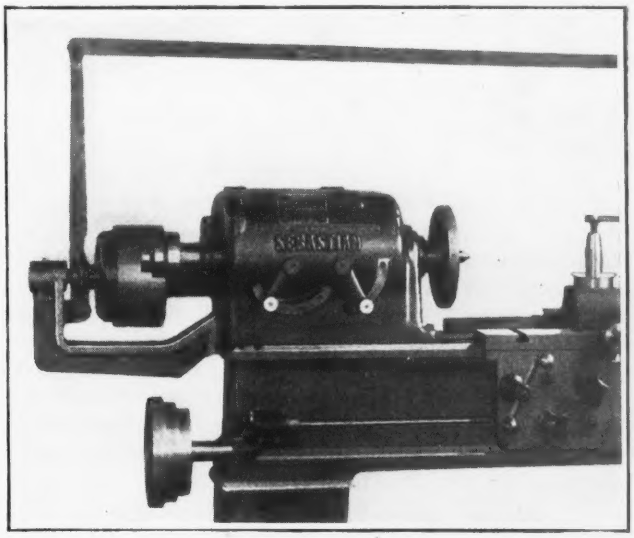


Tool-holder made by the Simmons Economy Tool Corporation

the front end of which is so constructed that a clamping member secures tool bits or the shanks of other tools, on a shoulder of the holder. The manner in which this clamp functions will be apparent by reference to the two views shown in the lower portion of the illustration, where a tool of circular cross-section is mounted in the holder at the left, while one of square cross-section is secured in the holder at the right. Several sizes of bits may be used in each tool-holder, as well as tools with straight or taper shanks, their rigidity being assured and chatter eliminated by the oscillating movement of the clamp on the binding screw and a supplementary screw which may be turned down by hand. The lower lip of the tool-holder is so constructed that the cutting edge of a bit is well supported. It will be obvious that this holder may be used in connection with taps, reamers, drills, countersinks, etc.

SEBASTIAN PLAIN TURNING LATHE

The Sebastian Lathe Co., Cincinnati, Ohio, is placing a machine on the market which is of the same design and specifications as the 13- and 15-inch types of geared-head lathe that were described in the September, 1917, number of MACHINERY, except that the lead-screw mechanism has been

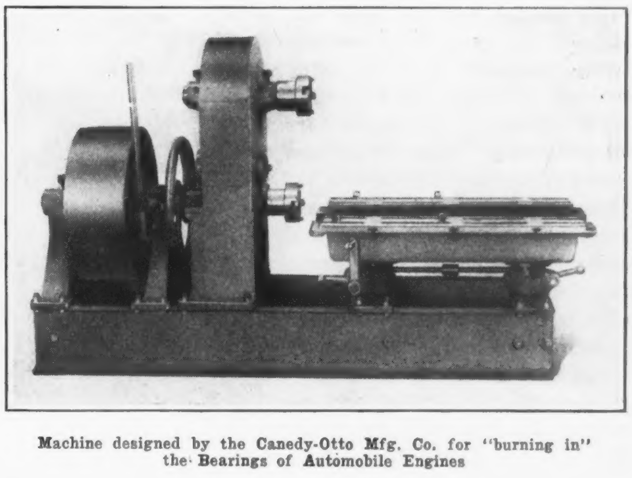


Head End of Plain Turning Lathe made by the Sebastian Lathe Co.

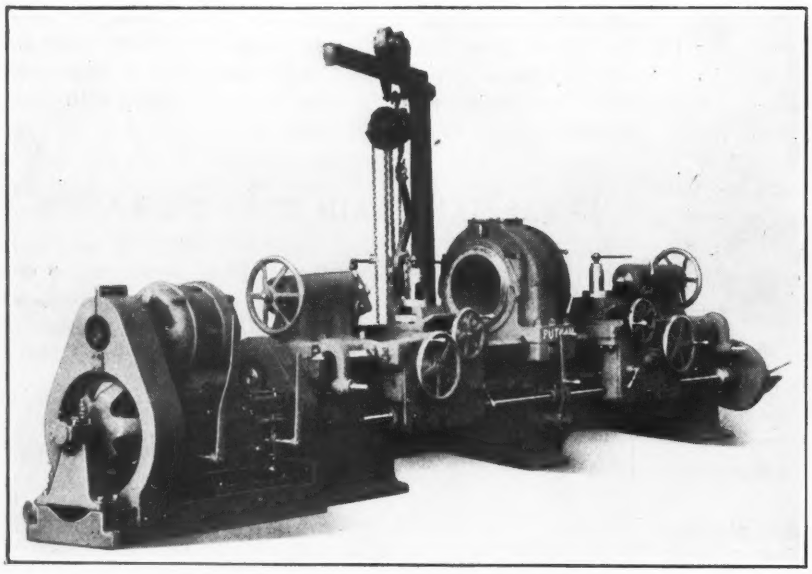
omitted and the driving arrangement altered. The machine as it is now designed is intended for plain turning operations only. The accompanying illustration shows the head end of the reconstructed lathe. The machine is driven by a 3-inch belt which may be connected directly to a line-shaft, because a countershaft is unnecessary due to the provision of a friction-clutch driving pulley. The clutch is operated by means of the overhead shifting device. In a test, a cut 5/8 inch deep in steel was taken with a 1/32 inch feed per revolution of the spindle. The new lathe is furnished with beds 4½, 5 or 6 feet in length.

CANEDY-OTTO UNIVERSAL "BURNING IN" MACHINE

A machine intended for automobile manufacturing establishments and repair shops which has recently been developed by the Canedy-Otto Mfg. Co., Chicago Heights, Ill., is the "burning in" or "running in" machine shown in the



Machine designed by the Canedy-Otto Mfg. Co. for "burning in" the Bearings of Automobile Engines



Heavy-duty Double Axle Lathe which is a Recent Development of the Putnam Machine Works of Manning, Maxwell & Moore, Inc.

accompanying illustration. This equipment is intended for "burning in" or "wearing in" new bearings placed in any type of automobile engine. The table of the machine may be raised and lowered to suit conditions, and is provided with clamps which may be adjusted to suit any engine. The table also serves as a sump or crankcase for the engine so that a crankshaft may splash in fresh oil. A 20-horsepower motor is sufficient to run the machine under the most severe conditions.

PUTNAM HEAVY-DUTY AXLE LATHE

The Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., have recently placed on the market the heavy-duty double axle lathe here illustrated. An axle placed on this machine is supported at each end by the center of a tailstock, and is driven at the middle by means of a special driving head having a drum with an opening 16 inches in diameter through which an axle can be passed. This drum is driven by a set of broad-faced herringbone gears, the pinion running in oil so that constant lubrication is afforded. Rotation is imparted to an axle by means of a double-tailed steel dog which bears against lugs on an equalizing plate. The driving head is clamped to the bed by means of six bolts.

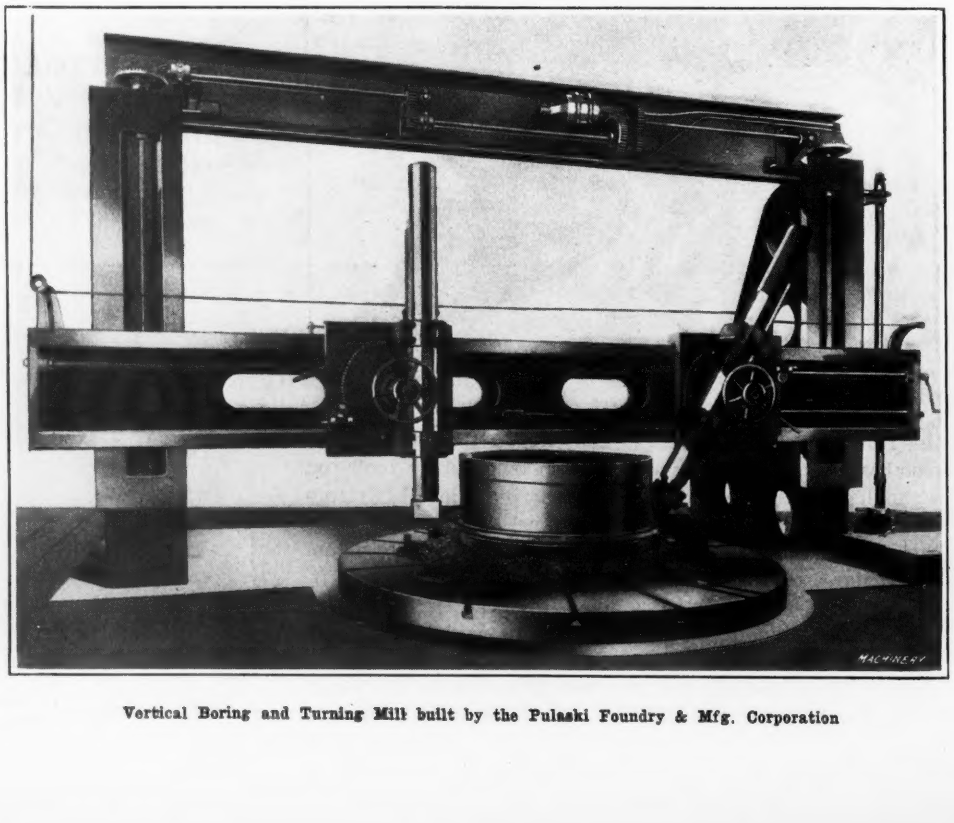
The two carriages are guided by large vees at the front and rear of the bed, and an additional flat bearing is provided directly beneath the toolpost. This construction furnishes a rigid support for the tools and reduces the span of the carriage bridge between the ways, eliminating distortion and binding of the carriage. The aprons are of double-wall construction and furnish support for shafts at both ends. The apron feeds are transmitted through worm and worm-wheel drives, each worm receiving its power from a shaft in the front of the bed. The feed is thrown in and out of engagement by a lever which operates a positive jaw clutch, and an automatic stop disengages the feeds at predetermined points. The feed change-gears are located at the right-hand end of the bed, and instantaneous feed changes are accomplished by operating a lever conveniently located at the center.

Both tailstocks are adjusted along the bed by means of racks and pinions, and permanent alignment of the spindles is maintained by means of tapered gibs. Pawls attached to the tailstocks engage racks on the bed and prevent slippage under heavy cuts. A one-man crane equipped with a one-ton quick-acting hoist can be furnished for placing axles on or removing them from the machine. Cutting lubricant is supplied to the tools by means of a centrifugal pump, which draws lubricant from a tank at the back of the bed. This machine can be furnished with any one of the four following types of drives: Single-pulley belt drive, four-step cone-pulley belt drive, constant-speed motor drive, and variable-speed motor drive.

PULASKI VERTICAL BORING AND TURNING MILL

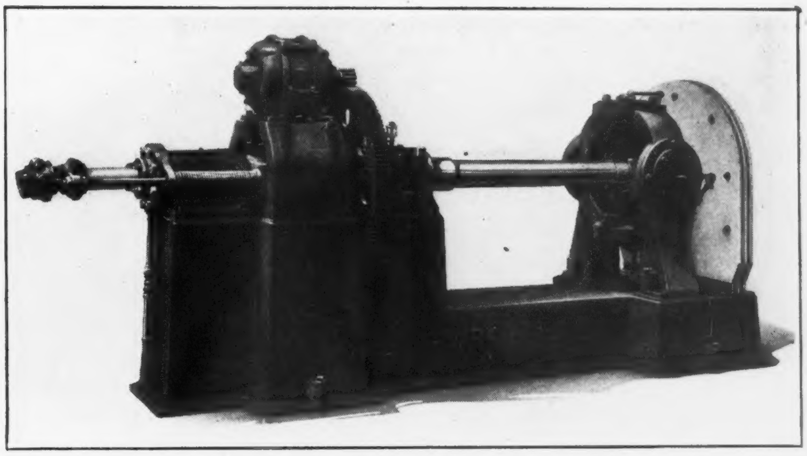
The Pulaski Foundry & Mfg. Corporation, 2422 Euclid Ave., Cleveland, Ohio, has placed on the market a new vertical boring and turning mill of the type illustrated. This machine is made in four sizes with swing ranging from 16 to 22 feet. The machine will be of special interest to jobbing and repair shops, shipyards, and large foundries handling roughly machined castings. The 20-foot size shown has an actual swing of 20 feet 4 inches, and has been in operation for a period of one year. The table is set just above the floor level with the base and spindle housing in a pit below the floor, but the machine may be set at a higher level if desired. The table is driven through an external gear of large diameter, the table spindle running in upper and lower bearings of liberal size, which are adjustable for wear. The table on the machine illustrated is 12 feet in diameter and can be provided with extension arms to carry extra large work. However, a larger table can also be furnished.

The boring-bars are carried by heavy saddles, and can be tilted up to an angle of 90 degrees in one direction and to



Vertical Boring and Turning Mill built by the Pulaski Foundry & Mfg. Corporation

an angle of 45 degrees in the opposite direction. Adjustable feeds from 0 to ¾ inch per revolution of the table are continuous and independent for each head. Vertical, cross, and angular feeds may be secured. Nine table speeds are available with a constant-speed driving motor. These speeds will usually meet all ordinary requirements, but should additional speeds be necessary, they may be obtained by using a variable-speed motor. The cross-rail is elevated and lowered by a separate 10-horsepower motor mounted on the housing brace, the power being transmitted through a train of gears to two elevating screws in the housings, carried on ball bearings. The maximum height under the tool-holders of all machines is 9 feet 3 inches, while the maximum height under the cross-rail is 10 feet. The minimum table speed obtainable is approximately 0.3 revolution per minute, while the maximum speed is about 8 revolutions per minute. Each machine is driven by a 40-horsepower motor.



Improved Type of Flue Welder built by the Southwark Foundry & Machine Co.

SOUTHWARK UNIVERSAL FLUE WELDER

An improved type of flue welder, built to meet the requirements of railroad shops, has lately been developed by the Southwark Foundry & Machine Co., Philadelphia, Pa., and is shown in the accompanying illustration. This machine embodies features essential to meet conditions that have arisen since the general adoption of the locomotive superheater. The principal feature of the machine is that it welds a flue on the inside, thus making the inside diameter of the flue at the weld the same as throughout the entire length. This method of welding is made possible by clamping the flue on the outside by four jaws or sections of a die, and rolling it with an expanding and collapsible mandrel.

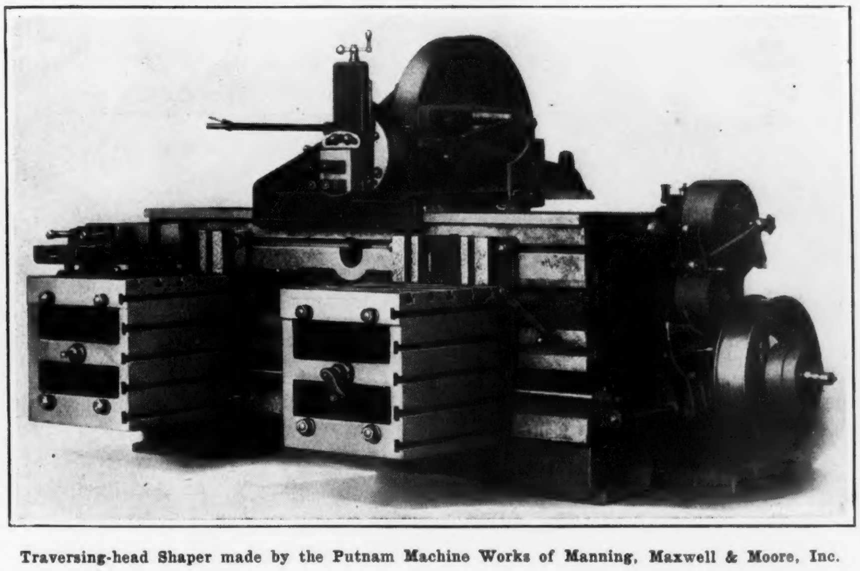
The clamping head of the machine is at the front, and the driving mechanism at the rear. Four air cylinders are mounted in the clamping head in such a manner that the cylinder heads can be removed from the outside. The pistons are fitted with metal snap rings, and the front end of each piston-rod is equipped with a clamping jaw or die section. A welding mandrel which fits the inside of the flue runs through the center of the head longitudinally with the machine. The body of this mandrel is hollow and contains three tapered rollers which can be moved radially by inserting a tapered arbor that reaches through the middle of the spindle from the rear of the machine. This arbor is operated by an air cylinder controlled by means of a foot-valve. A triple baffle of asbestos pressed board is furnished for deflecting the heat of the furnace from the welding head.

As the four clamping cylinders are connected to a single air line, they operate simultaneously with the opening of a single foot-valve, which controls all operations. This valve is usually placed in front of the furnace and on the left-hand side of the machine. The timing of different operations is controlled by the piping to this foot-valve, which is so arranged that the clamping head first comes in contact with the outside of the flues, then the clutch which rotates the mandrel is engaged and, finally, the expanding arbor is forced between the three rotating rolls in the mandrel, these rolls working the weld out against the clamping dies which also serve as an anvil. The time required for the actual rolling of a weld is from six to eight seconds. The total time for making a weld depends, of course, upon a number of factors, such as, for example, the size of the flue.

PUTNAM TRAVERSING-HEAD SHAPER

A 26-inch traversing-head shaper suitable for application in machine shops to general operations of the class for which this type of machine is generally employed, but intended particularly for railroad shops to be used in machining driving-boxes, shoes, wedges and driving-box crown bearings, has recently been added to the line of machine tools made by the Putnam Machine Works of Manning, Maxwell and Moore, Inc., of Fitchburg, Mass. The head of this machine is traversed across the bed by means of a large screw provided with a ratchet at the right end for engaging, disengaging, or reversing the various feeds which range from 0.01 to 0.17 inch. This head has a liberal bearing surface on the bed and is gibbed to compensate for wear. A nut in the head provides a ready means of disengaging the feed-screw when it is desired to traverse the head quickly along the bed by hand, through the employment of a handle on the end of the screw.

The ram is operated by a type of quick-return mechanism which practically insures a uniform cutting speed. Facilities are provided for quickly and conveniently setting the ram to any desired stroke or position. The tables are mounted on individual saddles, and may be adjust[illegible] vertically by rotating screws mounted on ball bearings. Longitudinal adjustments of the table are accomplished by ratchet handles attached to the saddles. A circular attachment may be supplied with this shaper. The machine may be driven by belt or constant-speed motor, being so arranged that the speed changes are

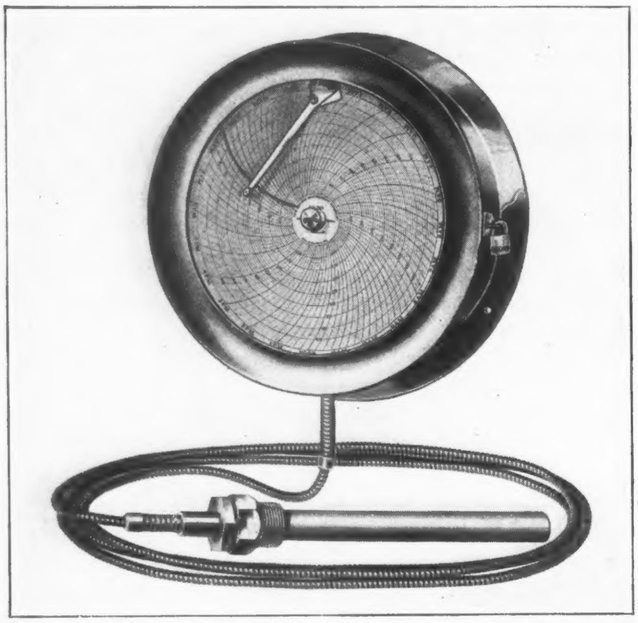


Traversing-head Shaper made by the Putnam Machine Works of Manning, Maxwell & Moore, Inc.

obtained through a selective-type gear-box. When furnished with beds 14 feet in length or longer, the machine is generally constructed double, the two heads being driven independently by separate motors.

BROWN RECORDING THERMOMETER

A recording thermometer for measuring the temperature of quenching and oil-tempering baths, etc., has lately been developed by the Brown Instrument Co., 4510 Wayne Ave., Philadelphia, Pa. The inverted pen arm on this instrument is adjustable by means of set-screws, and the pen is lifted automatically when the door of the case is opened. Patented clips automatically lock the chart when the door is closed. A Seth Thomas eight-day clock movement is attached to a front plate and can readily be removed when cleaning is necessary. The various charts carried as standard equipment range from those suitable for indicating temperatures of minus 40 degrees F. up to those for indicating temperatures of 1000 degrees F. Every instrument is furnished with a moisture-proof case.



Recording Thermometer made by the Brown Instrument Co.

BRIDGEPORT HERRINGBONE MILLING CUTTERS

A new line of general-purpose herringbone milling cutters has been placed on the market by the Bridgeport Cutter Works, Inc., 50 Remer St., Bridgeport, Conn. Each complete cutter consists of two opposite-angle spiral cutters fastened together with the teeth spaced alternately, the teeth overlapping slightly at the joint. A slight recess is provided opposite the inner cutting edge of each section to furnish adequate chip clearance. The angle of the cutting edges is about 20 degrees, and is usually slightly under-cut. The number of teeth on a cutter corresponds to general practice, and these teeth are made in either the standard or coarse type. The cutters are made in all standard sizes in widths up to 1½ inches. It is stated that this form of cutter makes it possible to take cuts at unusually high speeds and depths.

Milling Cutter made by the Bridgeport Cutter Works

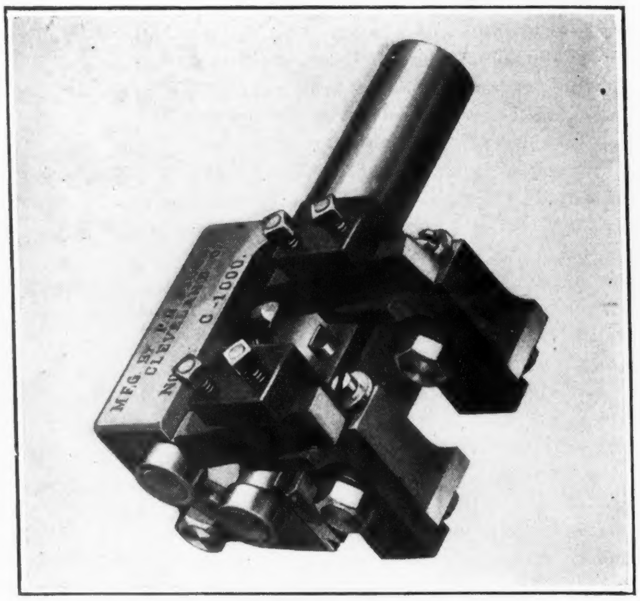


Fig. 1. Tangent-cut Box-tool made by the P. H. Biggs Machine Co.

BIGGS TANGENT-CUT BOX-TOOLS

Two styles of tangent-cut box-tools intended for high-speed production of screw products and other turned parts machined on automatic and hand screw machines and turret lathes have recently been placed on the market by the P. H. Biggs Machine Co., 1235-1237 W. 9th St., Cleveland, Ohio. These tools are made entirely of steel, and each component part is hardened. The style shown in Fig. 1 is intended for machining work of more than one diameter, while that shown in Fig. 2 is designed for turning work of a single diameter. Both styles can be furnished in right- and left-hand types. The cutting tools may be removed, sharpened, and replaced without disturbing the original adjustments, and the carriers of the box-tool shown in Fig. 1 are identical and interchangeable. The shank of each tool is hollow. The two styles are made in a number of sizes, and repair parts are carried in stock.

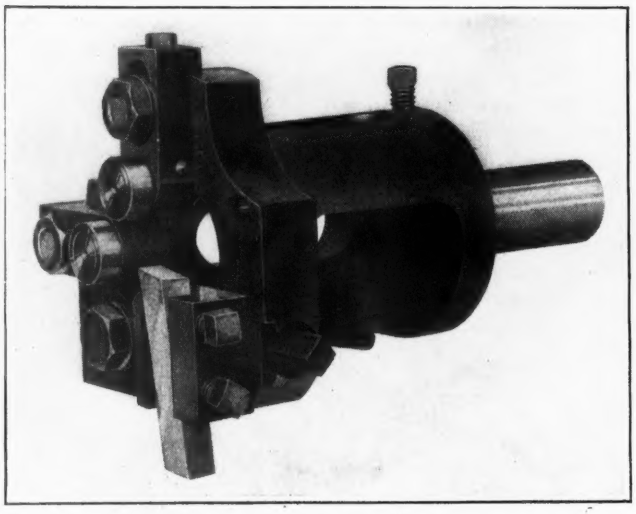
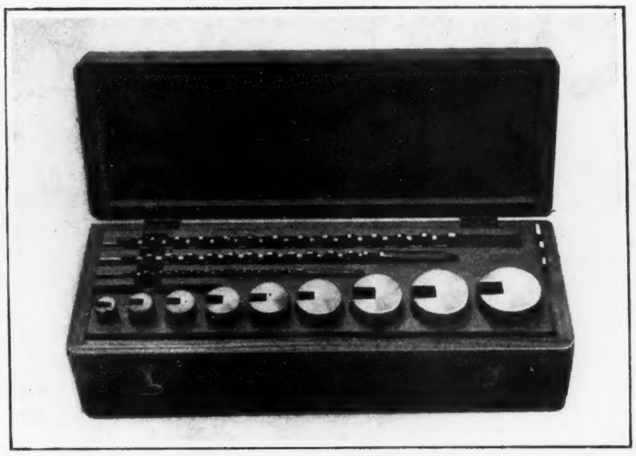


Fig. 2. Box-tool for machining Work of a Single Diameter

VELCO KEYWAY BROACHING SET

A keyway broaching set designated as the "Broach-well," which will be of especial interest to repair men and millwrights in garages and other shops where keyways are cut but where the amount of work does not warrant the purchase of a broaching machine, is shown in the illustration. This set of broaches has just been placed on the market by the Velco Mfg. Co., Inc., Greenfield, Mass. The tools are grouped in convenient sizes, permitting a wide range of

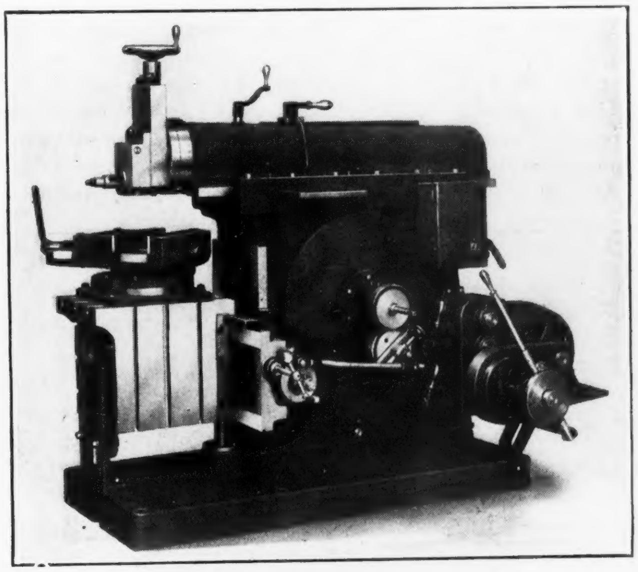


Handy Set of Keyway Broaches made by the Velco Mfg. Co., Inc.

keyways to be cut; and by the use of extra broaches which can be furnished, keyways of special shapes, such as dovetail and half round, may also be broached. The broaches are made of tool steel and have patented teeth. They are guided in an accurately sized bushing which adapts a broach to the desired depth of keyway. The method of using a broach in cutting a keyway is to place a bushing beneath an arbor press and force the broach through the work in exactly the same manner that an arbor would be removed from another part. Should more than one keyway be required in a piece, it is only necessary to turn the piece to the required angle on the bushing and repeat the operation.

HOLLINGWORTH HEAVY-DUTY SHAPER

A recent product of the Hollingworth Machine Tool Co., Covington, Ky., is the heavy-duty shaper here illustrated,

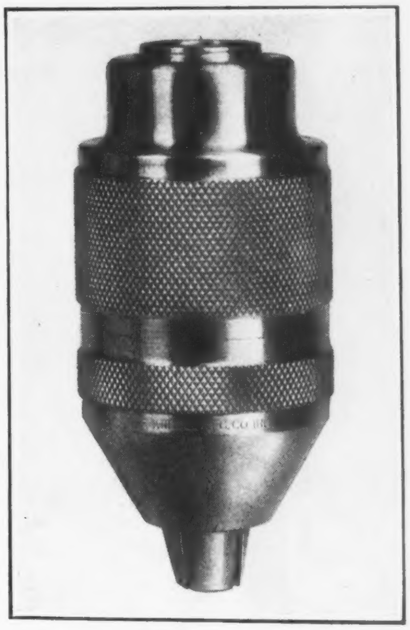


Heavy-duty Shaper made by the Hollingworth Machine Tool Co.

which is made in seven sizes ranging from 12 to 28 inches, the illustration showing a 28-inch size. During the designing stage endeavors were made to produce an especially rigid and accurate machine. For this reason it has been provided with taper gibs throughout and a number of graduated dials. The harp and vise swivels are provided with graduations to facilitate accurate settings of these units. The crank for operating the feeding mechanism is also furnished with graduations so that a predetermined feed can be instantly obtained. Feeding movements are reversed instantly by means of a plunger on the feed gearing. The length of stroke can be set accurately by means of a graduated scale on the column, and the ram is quickly positioned through miter gears and a screw. All the main bearings are bronze-bushed, and can be easily removed for replacement, while the driving gears are made of semi-steel, and the pinions of hammered steel.

KNEBEL SELF-TIGHTENING DRILL CHUCK

The Knebel Mfg. Co., Inc., 352 N. Burritt St., New Britain, Conn., is making the self-tightening drill chuck shown in the accompanying illustration, in which the jaws are driven through toggles, it being claimed that by the employment of this principle an unusually efficient drive is obtained. The thrusts on the chuck are absorbed by two sets of hardened steel balls, so located as to permit the easy removal of a drill. It is unnecessary to provide flats on a drill shank in order to prevent slippage when drilling a part, as the chuck will hold a drill securely without this provision. This chuck has a capacity for drills ranging from No. 60 to 17/32 inch in diameter. The greater the resistance met by the drill, the tighter the chuck grips, but it can be released by one hand.



Self-tightening Drill Chuck placed on the Market by the Knebel Mfg. Co., Inc.

TITAN QUICK-CHANGE COLLET CHUCKS AND SOCKETS

Improvements have been made in the design of the quick-change drill chucks and sockets made by the Titan Tool Co., 26th and Holland Sts., Erie, Pa., which were described in the May and July, 1920, numbers of MACHINERY. The improved types are shown in Figs. 1 and 2. The principal additional feature in the straight-shank drill chuck and socket shown in Fig. 1 is that the spring which actuates the sliding sleeve when the hand of the operator is released is now entirely enclosed. In the tapered-shank drill chuck and socket shown in Fig. 2, it will be seen that the tang of the drill extends through a slot in the closed end of the collet.

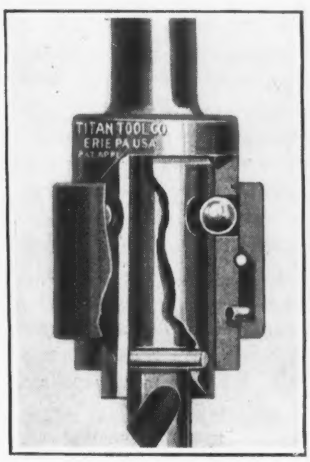


Fig. 1. Quick-change Drill Chuck and Socket made by the Titan Tool Co.

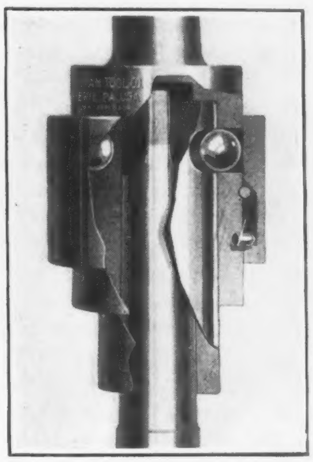
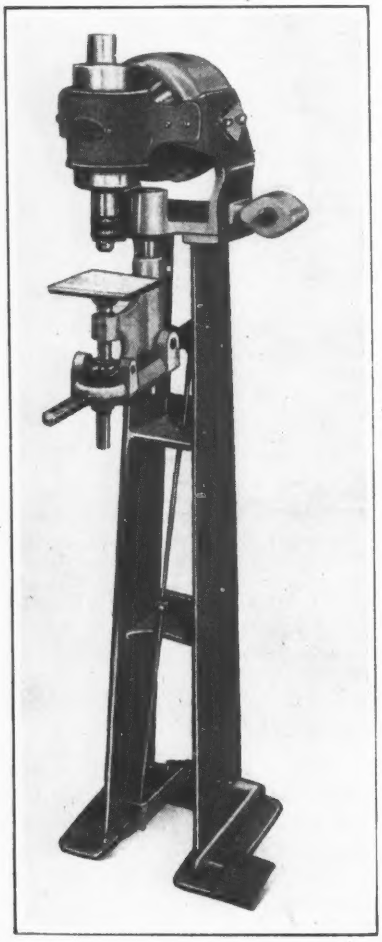


Fig. 2. Taper-shank Quick-change Drill Chuck and Socket

This construction permits easy removal of a drill from the collet by tapping the end of the tang. These chucks and sockets are equally adaptable to single-spindle and multiple-spindle drilling machines. They are made in two sizes, the smaller having a capacity for drills up to 5/16 inch in diameter, and the larger having a capacity for drills up to ½ inch in diameter.

ANDERSON VERTICAL TAPPING MACHINE

The Anderson Die Machine Co., Bridgeport, Conn., has recently developed a sensitive vertical tapping machine which is made in three styles, one of which is here illustrated. The other two styles are bench types, one being arranged so that the table is approximately on the level with the top of the bench, while the other is mounted on a short pedestal to bring the entire table mechanism above the bench level. The work is placed on the table or in a special fixture, and brought by means of either the hand or foot mechanism in contact with the tap carried in the chuck. The machine has an independent motor drive so that belt troubles are eliminated. The motor can be operated from an ordinary lamp socket. An advantage of this machine is that it can be moved from department to department easily. The size of the table is 4 by 4 inches, and its maximum adjustment, 6 inches. The machine has a capacity for tapping threads up to No. 6–32 in any material, and up to No. 10–32 in brass.

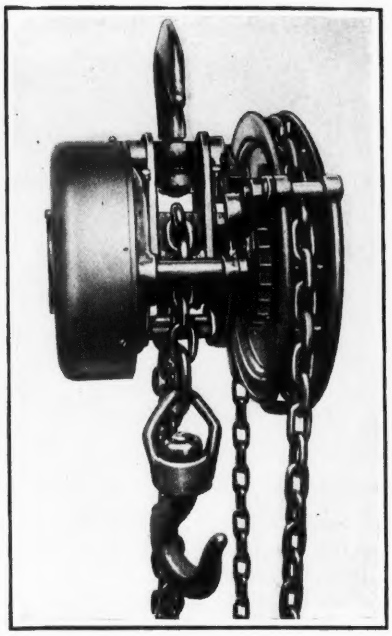


Sensitive Vertical Tapping Machine which is a Recent Product of the Anderson Die Machine Co.

G. B. SPUR-GEARED CHAIN BLOCK

André Weill & Co., Inc., 149 Broadway, New York City, have just been appointed exclusive agents in the United States and Canada by the Etablissements Beccat, Paris, France, for the sale of G. B. chain blocks manufactured by the latter. The New York concern now has in stock a line of the G. B. spur-geared chain blocks of the type illustrated, which are made in various sizes having capacities up to 20 tons. This chain block is provided with electrically welded chains, and the internal gear is a finished steel forging. In blocks up to 1-ton capacity, the driving pinion and load-sheave axle are a single drop-forging. On blocks of greater capacity the pinion and axle are two separate parts, but are assembled in such a manner that for power transmission purposes, the two parts serve as an integral piece.

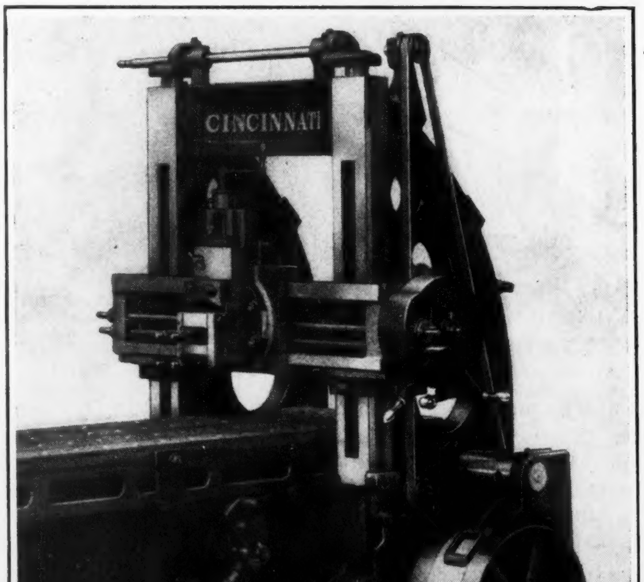
The load sheave is a steel drop-forging, machined carefully so that the chain links fit the corresponding depressions on the sheave without play, thus reducing wear to a minimum. The chain guides are hinged in order that the chain may be pulled from any angle without difficulty. It is claimed that by the exclusive employment of steel spur gears correctly cut, efficiencies of from 80 to 88 per cent are secured, and that the gear ratios are so calculated that the maximum lift speed is obtained with a minimum chain pull. Power is transmitted through the block by a planetary system of gearing. All gears are enclosed to protect them against injury from knocks, dirt, or weather. Each chain block is tested before leaving the factory at an overload of at least 50 per cent.



Chain Block for which Andre Weill & Co., Inc., are Sales Agents

CINCINNATI PLANER POWER TRAVERSE

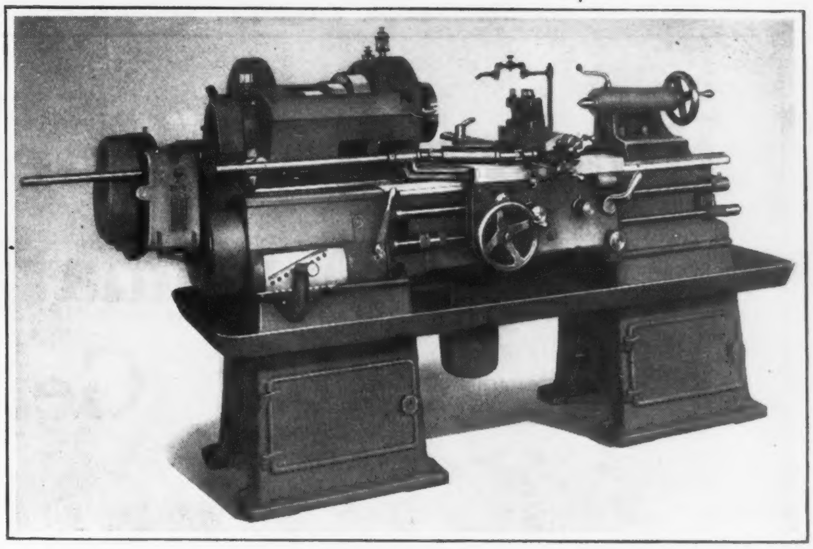
The Cincinnati Planer Co., Cincinnati, Ohio, has included a rapid power traversing mechanism on its 24- by 24-inch heavy-pattern planer. The work performed on machines of this size is usually small and the cuts are of short duration, a condition which necessitates frequent moving of the heads and changing of the tools. By means of the power traversing mechanism, which is shown in the accompanying illustration, constant winding of the crank handle is eliminated. The rapid power traverse can be engaged instantly, and when in operation the crank handle at the end of the traversing screw does not revolve. The new feature is provided on planers having either one or two heads on the cross-rail, and in the latter case, either head can be moved independently of the other or both can be moved simultaneously in either direction. All gearing is enclosed.



Rapid Power Traverse on Planer built by the Cincinnati Planer Co.

REED-PRENTICE CONE-HEAD LATHE

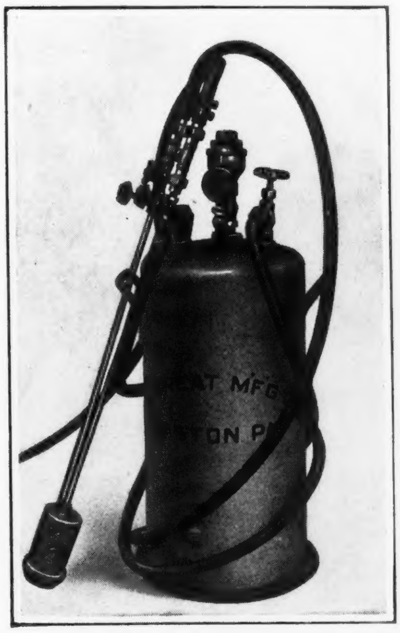
A description of the 14-inch geared-head lathe manufactured by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass., appeared in the February, 1920, number of MACHINERY. A machine of the same type but provided with a four-step cone pulley and a relieving attachment is shown in the accompanying illustration. This relieving attachment, however, is only furnished as special equipment. The swing over the ways of this machine is 16½ inches; the distance between centers on a 6-foot bed, 37 inches; the number of thread changes, 44; and the range of feeds, 0.0045 to 0.0667 inch. The weight of the machine equipped with a 6-foot bed and a compound rest is about 2850 pounds.



Fourteen-inch Cone-head Lathe built by the Reed-Prentice Co.

McKNEAT OIL-BURNING EQUIPMENT

The McKneat Mfg. Co., Easton, Pa., has recently placed on the market the oil-burning equipment here illustrated, which will be found especially useful in machine and repair shops for heating pulleys, wheels, etc., in order to expand them so that they may be placed on shafts on which they are to have a shrink fit, or to remove them from such shafts; in melting babbitt from bearings; in straightening bent shafts or girders; in case-hardening, tempering, and annealing parts; and in many other similar operations. The equipment is made for using crude or fuel oil or kerosene when compressed air is available and for using kerosene when compressed air is not available. The head of the burner tip is removable to facilitate replacement as it becomes worn.



Oil-burning Equipment made by the McKneat Mfg. Co.

NEW MACHINERY AND TOOLS NOTES

Combination Wall and Portable Drill: Black & Decker Mfg. Co., Baltimore, Md. A wall or post device designed to take the ⅜-, ½-, 9/16-, ⅝- and ⅞-inch sizes of the portable electric drill manufactured by this concern. The drill can be detached for portable work and may be readily re-mounted afterward.

Adjustable Boring-bar: Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. An adjustable boring-bar which can be furnished with any desired size or shape of shank, and which is made in various sizes to bore holes from 1½ to 9 inches in diameter. The position of the cutters is adjustable by means of a micrometer screw. After an adjustment, the cutters are locked in place by a wedge.

Drilling Machine Chuck: John Chuck Co., Milwaukee, Wis. A device intended for holding work while performing such operations as drilling, reaming, spot-facing, milling, centering, grinding, and tapping. This chuck is used chiefly on the tables of drilling machines. It is equipped with jaws made to conform to the work, which can be readily replaced to suit various shapes. The jaws are operated simultaneously by a right- and left-hand screw.

Tapping Chuck: John Chuck Co., Milwaukee, Wis. A reversing tapping chuck in which a tap is driven equally on each side of the shank. The chuck is equipped with a five-point positive and sensitive clutch, and it is stated that this clutch will disengage within a limit of 0.001 inch when the tap reaches a predetermined depth. The device may be used on any drilling machine without the necessity of providing a special counterweight on the machine spindle.

Combination Milling and Grinding Attachment: A. F. Robbins Co., 85 Moody St., Waltham, Mass. A combination adjustable milling and grinding attachment for bench and other small lathes, which permits the performance of milling and grinding operations without requiring the removal of work from the faceplate or the spindle. The base of this attachment is secured to the tool-block of the lathe, and the remainder of the device swivels upon a central stud on the base.

Radial Drilling Machine: Crescent Tool Co., Second and Elm Sts., Cincinnati, Ohio. A 2½-foot sensitive radial drilling machine intended for heavy-duty work. This machine is entirely gear-driven and furnished in two styles. One style is equipped with a hand feed only, but the other, in addition to the hand feed, has two changes of power feed and a quick-return motion. A variable-speed gear-box provides six spindle speeds in geometrical progression

Camshaft Lathe: Walcott Lathe Co., 115 Calhoun St., Jackson, Mich. A lathe which simultaneously turns the cams of a camshaft, the work being centered between chucks of the collet type and driven by these chucks. A cutting tool is provided for each cam, and these tools are moved forward and backward by means of a master cam located at the back of the machine. Each tool has a tilting motion while cutting the sides of a lobe, in order that the clearance and top rake will always be the same.

Self-opening Die-head: Modern Tool Co., 2nd and State Sts., Erie, Pa. A self-opening die-head known as the Style H, which is intended for general threading work and can be used in the turrets of hand or automatic screw machines. It can be fitted with a closing device so that it can also be used on drilling or other machines having a revolving spindle. The chasers are supported at their outer edge by a cam ring which, it is claimed, renders impossible the shifting of chasers during a threading operation.

Drill Grinding Machine: Bellevue Industrial Furnace Co., 715-717 Bellevue Ave., Detroit, Mich. A self-contained semi-automatic drill grinding machine with the driving motor located in the pedestal and equipped with a two-step cone-pulley drive to the spindle. Drills are ground on the periphery of the wheel, and the machine may be furnished with a carriage to facilitate the grinding of left-hand drills as well as right-hand drills. An indexing arrangement is provided for setting the drill properly for grinding each lip when drills with two or more lips are being ground.

Rotary Table for Milling Machine: Clark-Mesker Co., Cleveland, Ohio. A rotary table intended for the line of Cleveland milling machines built by this concern. The table

can be operated either by hand or power feed. There are sixteen changes of power feed controlled from the front of the knee by the same mechanism that controls the feed changes of the sliding table. The direction of rotation may be reversed by operating a lever. A crank and index-plate can be furnished for this attachment, and it may then be used in a similar way to ordinary dividing centers.

Tool-room Planer: Pratt & Whitney Co., Hartford, Conn. A planer intended for high-speed operation on tool-room work, which may be equipped with either a motor or belt drive. The table is driven by means of a rack and gear of the Maag form. The table dogs permit quick adjustments for the length of stroke without the use of a wrench and while the machine is running. When two heads are furnished on the cross-rail they are offset right and left to permit tools to be brought close together, and are provided with automatic feeds.

Tool-room Planer: George Gorton Machine Co., Racine, Wis. A planer especially designed for machining dies, jigs, and fixtures, which is built in two sizes, 24 by 24 inches and 30 by 30 inches, respectively. The machine may be furnished with one or two heads on the cross-rail and, in addition, has a side-head on the right-hand housing. In order to give greater strength and rigidity, the bed has been extended to the floor. The cross-rail heads are made right- and left-hand, and the vertical feed-screws have micrometer collars graduated in thousandths of an inch.

Form Grinding Machine: Bryant Chucking Grinder Co., Springfield, Vt. A form grinding machine which grinds pieces 10 inches long and of any diameter up to 12 inches by bringing the entire length of work simultaneously in contact with the wheel, the latter having no longitudinal movement. The work is carried on a bar and brought to the wheel by swinging the work-carrier, which is suspended from the bar. The wheel may be adjusted with respect to its distance from work-centers, but this adjustment is not used for feeding. After the wheel-head has been set for an operation, it has no further movement until it needs to be reset on account of wear.

* * *

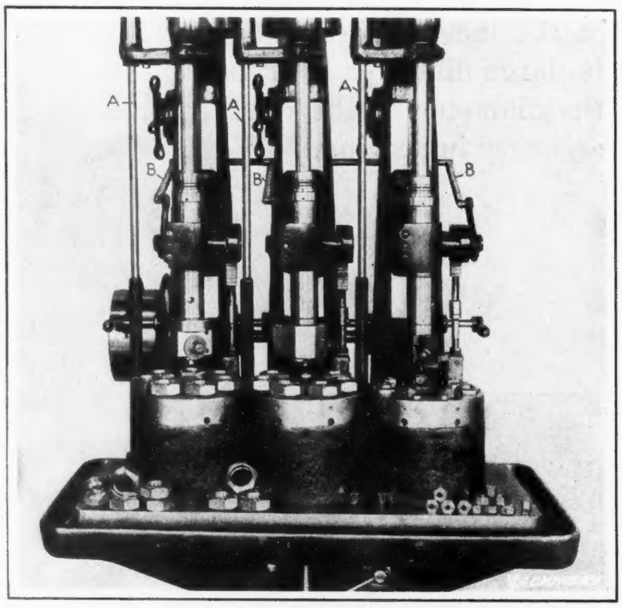
NUT FACING FIXTURE FOR DRILLING MACHINE

The fixtures with which the drilling machine here illustrated is equipped are used for facing the top surface and the bevel of hexagon, cast-brass, valve packing nuts, and will accommodate nuts from 1 inch to 2¼ inches across flats. They are designed to operate automatically, and are attached to a three-spindle No. 2B Edlund drilling machine, manufactured by the Edlund Machinery Co., Cortland, N. Y.

The machine is furnished with a standard drive, using four-step cone pulleys. The available spindle speeds are 510, 816, 1273, and 2038 revolutions per minute, with the drive pulley running at 500 revolutions per minute. The highest of these spindle speeds—2038 revolutions per minute—is too fast for the requirements of the job for which these fixtures are intended. Consequently, the high-speed step of the front cone pulley is utilized to furnish the power by means of which these automatic fixtures are operated. Extra large spindles were fitted to the machine, which were equipped with plain hardened steel and bronze thrust bearings at the lower end, for the purpose of taking the cutting thrust, and with ball thrust bearings at the upper end for supporting the weight of the spindle when running idle. It is necessary to remove about 1/16 inch of material in the facing operation, and the resulting finish must be smooth and free from chatter marks. Before loading in these fixtures, the work is faced on the bottom, drilled, and tapped.

These automatic fixtures consist of a revolving work-table, which may be indexed by a cam carried by a camshaft located at the rear of each fixture. This camshaft, which cannot be seen in the illustration, is driven by worm-gearing, the worm being attached to the vertical shaft *A*. This vertical shaft takes its power from the lower step of the front cone pulley, so that the drive for the fixture is governed by the previously selected spindle speed for the size of work being faced; thus any tendency to slow up or stop the spindle will also slow up or stop the operation of the fixture.

In addition to the cam that controls the indexing of the work-table through the medium of a pawl, the camshaft also carries two other cams. One of these cams operates a slide for locking and unlocking the work-table, and the other controls the feed of the spindle by means of the vertical turnbuckle and rack shown at the right of each spindle. The method of holding the smaller nuts from turning during the facing operation is clearly shown in the fixture at the right. For the larger size nuts, central plugs are employed, so located around the projecting center boss that one side of each nut will bear against it and prevent the nut from turning. The cam by means of which the spindle is fed is designed to approach the cut quickly, and then feed to the desired depth, allowing the tool to revolve several times after the facing operation is completed so as to give a smooth finish. The spindles are fed down against the tension of the long helical springs *B*, so that after the feed is completed, the spindle is returned by the pull exerted by these springs. A safety device has been incorporated in each fixture, which makes it impossible for the table to be indexed until the spindle returns to the end of its stroke.



Edlund Three-spindle Drilling Machine with Automatic Fixtures for holding Nuts

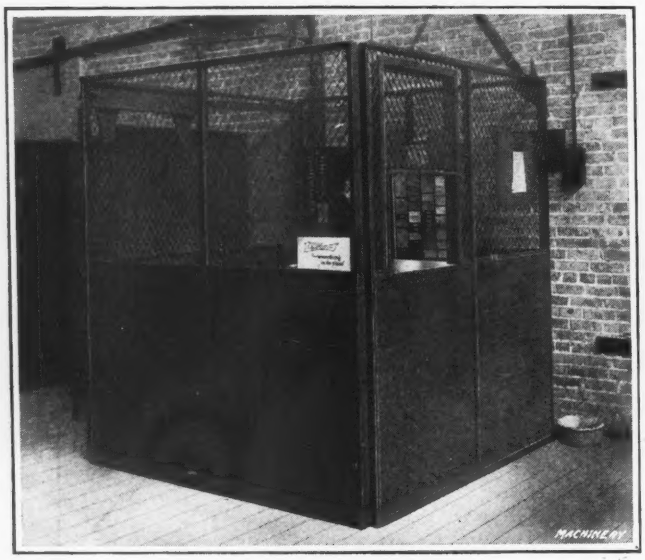
Each work-table has accommodations for seven nuts, and the center plugs for each nut have guide holes in the center for engaging the pilots on the tools, so that they will be guided and steadied while the cut is being taken. The work-table may be revolved by hand when not in operation, so that the work-plugs may be conveniently changed for different sizes of nuts.

The operator's only duty is to load and unload the fixtures and give general attention to the running condition of the machine. All three fixtures can be used for one size of work, or each may be fitted to accommodate a different size, if so desired. When each jig is to be used for a different size of nut, it is an easy matter to change the tools and the work-plugs, and select the proper speed for the tool. The loading and unloading of the nuts can be done while indexing or during the cut.

The production time for the 1-inch nuts is 100 per hour when all fixtures are in operation on the same size. The spindle speed is 1273 revolutions per minute in this case, and the feed 0.006 inch per spindle revolution. For the large nuts—2¼ inches across flats—the output is 420 faced nuts per hour, with the three spindles running at 510 revolutions per minute and the same rate of feed as used for the smaller nuts. For medium sized nuts with a spindle speed of 816 revolutions per minute, and the same feed, the output is 672 per hour, for the three fixtures.

BOOTH FOR SHOP TIMEKEEPER

A metallic booth intended to serve as an office for shop timekeepers, departmental foremen, and others requiring a convenient place for keeping records, etc., is shown in the accompanying illustration. This booth is a product of the



All-metal Booth built by the Lyon Metallic Mfg. Co. for the Use of Timekeepers, Foremen, etc.

Lyon Metallic Mfg. Co., Aurora, Ill., and is built from standardized sectional panels. It is furnished with a sliding window, and can also be provided with practically any arrangement of drawers, compartments, etc.

* * *

PERSONALS

Carl W. Bettcher has been appointed sales manager of the Eastern Machine Screw Corporation, New Haven, Conn. He will give special attention to the expansion of the H & G die-head business.

R. B. Hubbell, formerly sales manager of Churchill-Morgan-Crittsinger, Inc., Worcester, Mass., has resumed his former position as assistant sales manager with the Heald Machine Co., Worcester, Mass.

Morrison Nemirovsky, who was formerly connected with the firm of S. Nemirovsky & Son, will hereafter do business under the name of Philadelphia Machinery Exchange, with headquarters at 117 N. Third St., Philadelphia, Pa.

Charles O. Dowding, formerly manager of the machine tool department of Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, is now associated with Peter A. Frasse & Co., 417 Canal St., New York City in a similar capacity.

Keith J. Evans, advertising manager of Joseph T. Ryerson & Son, Chicago, Ill., was elected president of the Engineering Advertisers' Association at the annual meeting in Chicago on March 8. Mr. Evans succeeds J. J. Arnsfield, advertising manager of Fairbanks Morse & Co.

E. L. Essley, president of the E. L. Essley Machinery Co., Chicago, Ill., has recently purchased the entire interests of Frank S. Shields and others in the Cleveland Planer Co., and is now sole owner, president, and treasurer. W. B. Currier, Jr., is vice-president, secretary, and general manager.

W. H. Ellis and C. B. Clarke have joined the sales force of the Hilo Varnish Corporation, Marcy and Flushing Aves., Brooklyn, N. Y. Mr. Ellis was connected with the Forbes Varnish Co. for many years, and Mr. Clarke was with the Bridgeport Wood Finishing Co. for a considerable period of time.

Robert C. Weller has been appointed general sales manager of the Lakewood Engineering Co., with headquarters at Cleveland, Ohio. Mr. Weller is in full charge of sales work. Carlton R. Dodge has been appointed western sales manager of the company with headquarters at 1215 Lumber Exchange Bldg., Chicago, Ill.

H. S. Greene has been elected vice-president in charge of sales of the Barber-Greene Co., Aurora, Ill., manufacturer of belt conveyors and bucket loaders. Mr. Greene was for several years assistant sales manager of the National Carbon Co. of Cleveland, Ohio, and has been a director of the Barber-Greene Co. for some time.

William Roberts, formerly connected with the engineering department of the Rolls-Royce Co. of America, has opened engineering offices at 457 Main St., Springfield, Mass., where he is specializing in production and efficiency work. He will be glad to receive catalogues and literature on various production machines and tools now on the market.

L. F. Nielsen has resigned as chief engineer of the Shaw-Enochs Tractor Co. to engage in private practice in the field of machine and tool designing and production engineering, in partnership with W. C. Joubert under the name of Equitable Engineering Co. at 101-103 First Ave. N. This firm is also manufacturing the Joubert water circulating pump for Ford cars.

Clarence Walter Ham has been appointed associate professor of machine design at the University of Illinois, Urbana, Ill. Professor Ham has been an instructor at the University of Kentucky and an instructor and assistant professor at Cornell University, and has also been employed by the General Electric Co., and by the Gleason Works at Rochester, N. Y.

E. H. Sackett, formerly president and general manager of the Telluride Iron Works Co., Telluride, Col., has sold his holdings in the company and is now located in Denver, making a specialty of mine transportation, both underground and aerial. Mr. Sackett is contemplating erecting a factory in Denver to manufacture the Sackett sand and tailings pump as well as the Sackett simplex system of aerial tramways.

Charles E. Hildreth, who recently resigned the position of president and general manager of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., as mentioned in the November, 1920, number of Machinery, has been appointed general manager of Churchill-Morgan-Crittsinger, Inc., Worcester, Mass., manufacturer of grinding machines. He was also elected a director of the company. Mr. Hildreth is one of the most prominent machine tool men in the country, having been, as is well known, general manager of the National Machine Tool Builders' Association for five years.

M. Pierre Vassoille, general manager of the Société des Etablissements Beccat, Paris, France, is visiting this country in the interests of his firm, which is represented here by André Weill & Co., Inc., 149 Broadway, New York City. M. Vassoille and M. Maurice G. Roux, vice-president of André Weill & Co., are about to visit the larger cities in the United States and Canada to study trade conditions generally and to arrange for the representation and distribution of the G. B. line of chain blocks and hoists, one of the products of Etablissements Beccat, now carried in stock in New York by André Weill & Co., Inc.

A. S. Baldwin, 211 E. University Parkway, Baltimore, Md., has resigned as manager of ordnance and chief engineer of the Poole Engineering & Machine Co., Baltimore, Md. He has been in charge of all the munition work of the company during the last five years. During this period, Mr. Baldwin developed new guns for the army and navy, as well as special ammunition. Prior to his connection with the Poole Engineering & Machine Co., he was manager of one of the Westinghouse plants in Pittsburg, and previous to that was general manager of the Alberger Pump & Condenser Co., Newburgh, N. Y., for three years. He was general superintendent of the Driggs-Seabury Ordnance Corporation of Sharon, Pa., for four and a half years. Mr. Baldwin has not yet announced his future plans.

* * *

OBITUARIES

John Rahn, Jr., president and general manager of the Rahn-Larmon Co., Cincinnati, Ohio, died suddenly at his residence in Cincinnati on March 11, aged fifty-eight years. Mr. Rahn was born in Cincinnati in 1862, and was educated in the public schools of that city. At an early age he entered an apprenticeship course of the Sebastian Lathe Co. of Cincinnati. Later he became foreman and superintendent of the G. A. Gray Co. In 1898 he entered business for himself, manufacturing lathes in Cincinnati. The firm was known as the Rahn, Mayer, Carpenter Co., and Mr. Rahn held the position of vice-president and general manager. In 1910 he became president of the company, the name then being changed to the Rahn-Larmon Co., and held that position up to the time of his death.

COMING EVENTS

April 7—Monthly meeting of the Indianapolis Chapter of the American Association of Engineers at the Chamber of Commerce, 28 S. Meridian St., Indianapolis, Ind.

April 18-21—Convention of the National Metal Trades Association in New York City; headquarters, Hotel Astor. Secretary, Homer D. Sayre, Peoples Gas Bldg., Chicago, Ill.

April 27-29—Convention of the Society of Industrial Engineers in Milwaukee, Wis. Business Manager, George C. Dent, 327 S. La Salle St., Chicago, Ill.

April 27-30—Fifth annual meeting of the American Gear Manufacturers Association in Cincinnati, Ohio; headquarters, Hotel Sinton. Secretary, Frank D. Hamlin, 4401 Germantown Ave., Philadelphia, Pa.

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel.

May 19-20—Spring convention of the National Machine Tool Builders' Association in Atlantic City, N. J.; headquarters, Hotel Traymore. General manager, E. F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 24-28—Summer meeting of the Society of Automotive Engineers in West Baden, Ind.; headquarters of the society, 29 W. 39th St., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. National office of the society, 4600 Prospect Ave., Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

Grove City College, Grove City, Pa. Catalogue giving calendar and courses of study for the year 1920-1921.

Columbia University, Morningside Heights, New York City. Bulletin of information containing announcement of the day and evening courses offered at the twenty-second summer session, which begins July 5 and ends August 12. Registration in the summer session begins on June 30, and a statement of the regulations regarding registration by mail may be obtained from the Registrar, Columbia University.

NEW BOOKS AND PAMPHLETS

Weights and Measures. 200 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Miscellaneous Publication No. 43 of the Bureau of Standards. Price, 20 cents.

This pamphlet contains the minutes of the thirteenth annual conference on weights and measures attended by representatives from the various states, which was held at the Bureau of Standards, May 24-27, 1920. The conference discussed the standardization of units of weights and measures and methods of inspection for the detection of fraud.

Table for Computing Change-gears for Machines Hobbing Spiral Gears. By John M. Christman. 10 pages, 5¾ by 7¾ inches. Published by the author at 934 W. Philadelphia Ave., Detroit, Mich. Price, 50 cents.

This pamphlet contains formulas for computing lead of spiral for spiral gears, feed to be used in hobbing spiral gears, and ratio of index-gears and feed gears. The formulas and examples illustrating their use cover the first two pages of the book, and the remaining eight pages contain tables for computing change-gears for machines hobbing spiral gears, when cutting right-hand spirals with right-hand hobs, or left-hand spirals with left-hand hobs; and when cutting right-hand spirals with left-hand hobs, or left-hand spirals with right-hand hobs.

Cams—Elementary and Advanced. By Franklin DeRonde Furman. 234 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 432 Fourth Ave., New York City. Price, $3.

The first five sections of this book were published about three years ago under the title "Elementary Cams." The chief features of the earlier book were that it pointed out a classification, and the general method of solution of the well-known cams. It also gave a series of cam factors for base curves in common use, so that designers could compute proper cam sizes for specific running conditions, numerous examples of the use of these factors being given in the different kinds of cam problems presented. A further development of this subject, in addition to the original matter, is given in the present work. The chief original features of the advanced section include the development or use of the logarithmic, cube, circular, tangential, and involute base curves, the establishing of cam factors for such of these curves as have general factors, and the demonstration that the logarithmic base curve gives the smallest possible cam for given data. Numerous problems in cam design and their solution are included.

The Welding Encyclopedia (1921). 326 pages, 6 by 9 inches; 375 illustrations. Published by the Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill. Price, $5.

This work, which is a reference book on autogenous welding, was compiled and edited by L. B. Mackenzie and H. S. Card of the editorial staff of the "Welding Engineer." One-third of the book comprises a dictionary, giving definitions of terms and trade names used in the welding industry, and containing short articles on welding topics. Then follow chapters on the oxy-acetylene, electric arc, electric resistance, and thermit processes, in which instructions are given for welding different kinds of metal. The use and care of the equipment are also discussed. A special chapter is devoted to boiler welding, and another to the heat-treatment of steel. Tables and charts show graphically the right and wrong methods of preparing welds. The last section is a catalogue section, containing announcements of various manufacturers of welding equipment and supplies, as well as a buyers' index, which enables the reader to locate readily the makers of all kinds of welding apparatus.

Export Packing. By C. C. Martin. 710 pages, 6 by 9 inches. Published by the "American Exporter," 370 Seventh Ave., New York City. Price, $10.

The great importance of good packing as a factor in successful merchandising is emphasized in the present work, which should be of interest in view of the fact that so much attention is being given at the present time, to the development of foreign trade. American methods of packing goods for shipment to foreign markets have invoked considerable criticism for many years. In this book the author has made a constructive attempt to supply the knowledge and technique by means of which such criticism may be eliminated. The book explains the application of principles of economical and efficient packing to all classes of commodities, from fragile glassware to heavy machinery. More than 350 photographs, diagrams, and drawings are reproduced to illustrate the methods employed by successful exporters in every line. Aside from its usefulness to exporters, it contains much information applicable to the problems of domestic shippers, especially those who make use of coastwise lines.

Inorganic Chemistry. By James Lewis Howe. 443 pages, 6 by 9 inches. Published by the Chemical Publishing Co., Easton, Pa. Price, $4.

This book is an enlarged and revised edition of "Inorganic Chemistry According to the Periodic Law," by F. P. Venable and J. L. Howe. The material has been thoroughly revised and much of it has been rewritten in the light of recent developments of chemistry, but no attempt has been made to incorporate many of these advances into what is essentially a text-book of elementary chemistry for beginners, or for those who have had at the most a high school course. The experiments accompanying the text are those that have been found by experience to impress the subject upon the student. Elaborate experiments have been omitted, and those presented are intended to be carried out under the direct supervision of an instructor. The eleven chapters included are headed as follows: Hydrogen, Oxygen and Water; Salt, Sodium and Chlorine; Classification of the Elements; the Elements; the Compounds of Hydrogen; the Halides; Oxides and Sulphides; Binary Compounds of Group V; Binary Compounds of Groups IV and III; Alloys; and Outlines of Metallurgy.

Machine Shop Practice. By James A. Pratt. 320 pages, 6 by 9 inches; 205 illustrations. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.50.

The elements of machine shop practice are presented in this book, which is intended to be used as a text for the machinist's trade. The work has been devoted to the trade fundamentals applicable both to the doing of bench work and to the operation of machine tools. The processes described are related to the bench, lathe, drilling machine, shaper, slotter, grinder, miller, and planer; and the construction of these machines is described, and illustrated by means of diagrammatic views on which all the various parts are numbered so that they can be readily designated. The author believes that a study of these machines will give a satisfactory understanding of the fundamental processes involved in the metal-working industries. The book contains fifteen chapters, headed as follows: The Bench and Bench Work: Supplies and Miscellaneous Tools; Hardening and Tempering—Machine Adjustments —Equipment—General Tools; Lathe Tools; the Lathe Back-rest—Follow-rest—Compound Rest—Eccentric Turning; the Driller or Drill Press; the Shaper; the Slotter; the Grinder; Grinding (Continued); the Milling Machine or Miller; Gearing; the Planer; Machine Shop Calculations; Machine Glossary—Tables—Bibliography—Course Outline.

Modern Apprenticeships and Shop Training Methods. By Erik Oberg. 118 pages, 6 by 9 inches; 38 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

The object of the present book is to describe in considerable detail the methods used in several well-known machine building plants in the country. As the machine tool industry is the basic industry in the whole machine building field, the examples have been mainly taken from the machine tool field. The book deals not only with regular apprentice systems and apprentice schools, but also with training shops for machine operators that do not serve regular apprenticeships. A chapter is included on the training of electric welders in order to indicate how specialists in various fields may be trained, and the book concludes with a chapter on the training of women for shop work, based upon the experience of several American machine shops during the war. It is the hope of the publishers and the author of this book that it may stimulate the interest in apprenticeships and training courses and that manufacturers and others interested in this work may be able to obtain from it a comprehensive idea of what has been done elsewhere in order to bring about more satisfactory means for the training of the men who will be mainly responsible for the output of American machine shops in the future.

NEW CATALOGUES AND CIRCULARS

E. C. Atkins & Co., Inc., Indianapolis, Ind. Revised list prices, supplementing Catalogue 18, of Atkins mill saws and specialties.

Albro-Clem Elevator Co., Erie Ave. and D St., Philadelphia, Pa. Loose-leaf circulars illustrating Hindley worm drives for heavy duty.

Metalwood Mfg. Co., Detroit, Mich. Circular B-38, containing price lists of drop-forged hydraulic fittings for working pressures of 3000 and 6000 pounds.

Wagner Electric & Mfg. Co., St. Louis, Mo. Bulletins 127 and 128, treating of Wagner single-phase motors, and distribution type transformers, respectively.

Trane Co., La Crosse, Wis. Bulletin 6-A, containing records of performance tests of Trane thermetal radiator traps, conducted by an eastern university and by the Trane Co. in its own laboratories.

Springfield Machine Tool Co., 631 Southern Ave., Springfield, Ohio. Catalogue illustrating and containing brief descriptions of the line of lathes, shapers, and straightening presses made by this company.

Griscom-Russell Co., 90 West St., New York City. Bulletin 615, illustrating and describing the G-R multi-screen filter, which is a new design of the Reilly multi-screen feed-water filter and grease extractor.

Nicholson File Co., Providence, R. I. Catalogue for 1921, containing the reproduction of an advertisement from MACHINERY, in which attention is called to the widespread use of Nicholson files in the city of Detroit.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Publication 2016 entitled "Start her up Bill," illustrating and describing the Cutler-Hammer enclosed "safety" switch, used for starting polyphase squirrel cage motors.

Baird Machine Co., Bridgeport, Conn. Circular treating of the Baird tandem press, which is made in double-action and single-action types, for performing two series of drawing, stamping, piercing and similar operations.

Crouse-Hinds Co., Syracuse, N. Y. Circular showing the application of ZY "Condulets" for the control of small motors; they are furnished with a 250- or 600-volt, 3- or 4-pole snap switch for motors of 2 horsepower or less.

Consolidated Instrument Co. of America, 461 Eighth Ave., New York City. Circulars illustrating and describing the Hasler speed indicator and Jones tachometers, for which this company has recently acquired the exclusive right of distribution in the United States.

Cincinnati Electrical Tool Co., Cincinnati, Ohio. Catalogue 14, covering the company's complete line of portable electric drills, grinders, and buffers. The catalogue shows several new types of machines which have recently been brought out. Copies will be sent upon request.

Ratiometer Corporation, 366 Gerard Ave., New York City. Technical letter No. 1, containing a brief description of the construction and operation of the ratiometer, a mechanical device for the automatic proportioning of gaseous fuels and the air used for their combustion.

General Electric Co., Schenectady, N. Y. Bulletin 49714 C, treating of condensers of the static or stationary type, which have been developed to overcome the detrimental effect of a low power factor for comparatively small loads. Bulletin 48034 (superseding X-407), entitled "Electrical Equipments for Movable Highway and Railway Bridges," describing both alternating- and direct-current equipments.

Skelton Tool Co., 406 Ash St., Syracuse, N. Y. Circular illustrating several typical examples of the Skelton line of production tools, including high-speed roughing reamer, helical finishing reamer, high-speed taper pin reamer, and boring-bar with a high-speed cutting end welded to a nickel-steel shank.

Hercules Machine & Tool Co., Inc., Broome and Lafayette Sts., New York City. Bulletin illustrating and describing Hercules gear-hobbing machines, made in 8- and 24-inch sizes. Tables of gear tooth parts and rules for calculating spiral gear dimensions, as well as dimensions of standard hobs are included.

J. G. White Engineering Corporation, 43 Exchange Place, New York City. Catalogue entitled "Achievement," showing different classes of construction which this company has undertaken, including steam power plants, hydro-electric developments, transmission systems, industrial plants and buildings, etc.

Watson Mfg. Co., Toledo, Ohio. Catalogue describing the different types of Watson tangent-cut box-tools, illustrating and describing the different models of box-tools made by the company for automatic and hand screw machines, and giving complete dimensions of the tools, as well as directions for their setting and operation.

Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. Bulletin 607, containing a detailed description and showing several applications of Chicago pneumatic oil engine driven compressors, which are built in both stationary and portable types. The booklet gives a comparison of the operating costs of these machines and of steam-driven compressors.

American Roller Bearing Co., Pittsburg, Pa. Bulletin 1005 treating of standard and heavy-duty Type C roller bearings. Characteristics of the bearings are outlined, and information is given relating to the installation, lubrication, and load capacities. There are several pages of illustrations showing the wide application of Type C roller bearings to machinery and equipment in general.

Universal Boring Machine Co., Hudson, Mass. Instruction book containing instructions for operating Universal horizontal boring machines. The construction of the machine is made clear by both halftone and line illustrations, and the correct method of handling is shown graphically by a large number of illustrations. The instructions cover operating, leveling, adjusting, dismantling, and oiling. The list of parts of the machine is printed both in English and in French.

Neil & Smith Electric Tool Co., Cincinnati, Ohio. Drill Bulletin No. 9, containing data on the portable electric drills made by this company, which are furnished for operation on universal or direct current. The bulletin reproduces data covering a competitive test of portable drills, which gives an idea of the capacity of the Neil & Smith tools. A price list is issued in conjunction with the drill bulletin, giving prices of drills, grinders, or buffers; screwdrivers; circular wood saws, etc.

Sterling Grinding Wheel Co., Tiffin, Ohio. Circular containing price lists for Sterling grinding wheels from 1 to 24 inches in diameter, and from 1/4 to 4 inches thick. The circular also contains a table of grinding wheel speeds and a grading table, showing the proper grain and grade of wheel to be used for different kinds of work. Circulars containing suggestions for care, operating, and stopping of grinding wheels; sizes of Sterling swing-frame grinders; and dimensions of Sterling No. 5/8 and 1/2 grinders.

Jones & Lamson Machine Co., Springfield, Vt. Cloth-bound book illustrating and describing in detail the construction and principle of operation of the Hartness screw thread comparator—a machine designed on the principle of the projection lantern, for use in measuring the essential elements of a screw during the course of manufacture and for inspecting threaded work accurately and rapidly. The book reproduces a large number of screw thread projections to illustrate the manner in which errors are revealed by the Hartness machine.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 114, descriptive of the line-reaming of bearings by the Martell system. The bulletin describes the construction of Martell reamers in detail, as well as their principle of operation. Illustrations show the use of the aligning reamer for reaming crankshaft bearings in multi-cylinder engines. Bulletin 115, illustrating and describing Martell adjustable reamers, of the hand, chucking and shell types. Instructions are given for grinding the blades of Martell reamers, as well as tables of dimensions for the different types.

Barnhart Bros. & Spindler, Monroe & Throop Sts., Chicago, Ill. Circular containing illustrations of parts produced from "Tenso" alloy by the die-casting process, as well as information relating to the physical properties and uses of these die-castings. The circular gives tables of comparative strength, lightness, and hardness of "Tenso" alloy and other metals. These die-castings are suitable for small parts, such as are used in the automobile and accessories trade, airplanes, electric motors, gasoline engines and pumps, typewriters, time recorders, vacuum cleaners, etc.

Bowen Products Corporation, Auburn, N. Y., has published two booklets relating to lubrication of motor cars and chassis, written by C. A. Bacon. One of the booklets, entitled "Chassis Lubrication," discusses methods of applying lubricants to chassis, and points out the conditions under which oil is most suitable and those under which grease is preferable. The other booklet entitled "Lubricants and their Application as Related to the Chassis" contains the results of a series of tests made to determine the best lubricant to use for automobile chassis, and its proper application.

TRADE NOTES

Progressive Mfg. Co. is a new concern organized in Cincinnati, Ohio, at 5th and Elm Sts. The specialty of the company will be diemaking and die designing.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has moved its Pittsburg office from 1208 Farmers Bank Bldg., to 718 Bessemer Bldg., corner of 6th St. and Duquesne Way.

Deutschle & McKinley is a new concern organized in Cincinnati, Ohio, at 1623 John St., to engage in work as general machinists, with lithographic and printing machinery as a specialty.

Wagner Electric Mfg. Co., St. Louis, Mo., has removed its Boston office and service station to larger quarters at 342 Newbury St., where it occupies the entire building. Brooks Faxon will continue in charge as district manager.

Southwark Foundry & Machine Co., Philadelphia, Pa., has opened a district office in Cleveland, Ohio, at 804 Swetland Bldg., which is under the management of Stewart Bolling, who has been engineering salesman for the company for seven years.

George B. Limbert Co., Chicago, Ill., manufacturer of pipe fittings, is offered for sale by the Northern Trust Co., trustee of the late George B. Limbert. The physical valuation made by the Sessions Engineering Co. shows a property of about $1,500,000.

Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, have acquired the good will and all the physical assets of Patterson, Gottfried & Hunter, Inc., 211 Center St., New York City, dealers in machinery, metals, hardware, tools, and supplies.

Stewart Mfg. Corporation, 4500 Fullerton Ave., Chicago, Ill., manufacturer of die-molded castings and bronze-back bearings, announces the establishment of a permanent Cleveland office at 419 Bangor Bldg., 942 Prospect Ave. E. P. Grismer, who has long been identified with this industry, will be in charge of the Cleveland territory.

Greiner, Semon, Lowry Co., Syracuse, N. Y., has been organized as a copartnership for the manufacture of special machinery and tools, by John A. Greiner, Joseph C. Semon, and Edward N. Lowry. A new steel and brick factory, 40 by 126 feet, with an adjoining wing, 24 by 52 feet, of one-story construction, is being built at 419 W. Taylor St., Syracuse.

Conveyors Corporation of America (formerly the American Steam Conveyor Corporation) 326 W. Madison St., Chicago, Ill., manufacturer of the American trolley carrier and the American steam ash conveyor, announces that it has become necessary, owing to the steady increase in its business, to double the number employed in its South Bend, Ind., plant.

Bacharach Industrial Instrument Co., Pittsburg, Pa., is now situated in a new plant at Bennet St. and Murtland Ave., Homewood Station, Pittsburg, which is a brick building having a floor space of 18,000 square feet. The additional space was acquired by the purchase of the building, and has considerably increased the facilities of the concern. It is announced that manometers and engine indicators have been added to the company's regular line of products.

Chicago Belting Co., 127 N. Green St., Chicago, Ill., has opened a New England branch office at 30 South St., Boston, Mass. Elmer J. McManus, who has had ten years' experience marketing leather belting and leather specialties in New England, is branch manager. The Boston branch carries a large stock of the company's brands of leather belting and leather specialties, and maintains a complete service department for installing belts, etc.

Charles Eisler Engineering Co. is successor to the **National Machine & Tool Co.**, of Newark, the assets of the latter company having been purchased by Charles Eisler, consulting engineer, 159 Clifton Ave., Newark, N. J. The company will manufacture gear testing machines, as well as incandescent lamp machinery, in addition to carrying on its regular consulting engineering and machine designing business. The factory and offices are located at 15 Kirk Place, Newark.

American Gas Furnace Co. announces that its entire personnel is now concentrated in a main office in Elizabeth, N. J., where the two plants of the company are located. This change was made to insure a more thorough cooperation of the various departments, and to place the entire organization more intimately at the disposal of its customers. It is also announced that the company has discontinued selling operations through its former sole agent E. P. Reichhelm & Co., Inc.

Myerstown Foundry & Mfg. Co., Myerstown, Pa., has recently purchased the plant that it has been operating for a number of years from the Treadwell Engineering Co., and intends to effect a number of improvements. During the last year the entire plant has been completely electrified. The company maintains a fully equipped gray iron foundry, pattern, forge, and machine shop, and expects to purchase a number of new tools in the near future. The officers are L. F. Krum, president; E. R. Euston, vice-president; and S. P. Line, secretary-treasurer.

Smith Engineering Co., 1 Union Square, New York City, has been organized for the purpose of conducting a mechanical engineering and contracting service. The engineering service will provide facilities for the designing and building of automatic machinery, tools, dies, gages, etc., the planning and development of efficient production methods, and the handling of contract production work. The firm will also be in a position to equip and appraise manufacturing plants, conduct factory investigations, and plan and install refrigerating machinery and factory water cooling systems.

Dwight P. Robinson & Co., Inc., engineers and constructors, 125 E. 46th St., New York City, have recently opened branch offices in Montreal in the Dominion Express Building. Alexander C. Barker, vice-president, is in charge of the office. The company is a consolidation of Westinghouse, Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc., and has done extensive construction and engineering work in Canada for the Canadian Pacific Railway, Canadian Salt Co., Canadian Crocker-Wheeler Co., Dominion Government, Aetna Explosives Co., Grand Trunk Railway, and others.

Surface Combustion Co., Inc., 366 Gerard Ave., New York City, manufacturer of industrial furnaces, has acquired the entire rights and interests of the **Ratiometer Corporation**, Rochester, N. Y. The Surface Combustion Co., Inc., has established a separate manufacturing and sales organization in its own plant in New York, where it will continue this business under the name of the Ratiometer Corporation. Other patent rights recently acquired by the Surface Combustion Co., Inc., are the Clark principle of intermittent firing for enameling furnaces and the Langenberg-Fetterly furnace for heat-treating armor piercing shells.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York City, announce that they have found it advantageous to recapitalize and incorporate the company in the state of Delaware. Consequently it was necessary to dissolve the New Jersey corporation and sell all its interests to the Delaware corporation bearing the same name. There has been no change in the personnel or policy, except that the number of directors has been increased. The officers of the concern are William F. Schlemmer, president and treasurer; August Pahl, first vice-president; Herman Acher, second vice-president; and William H. Siebert, secretary.

J. H. Williams & Co., manufacturers of drop-forgings and drop-forged tools, with works at Brooklyn, Buffalo, Chicago, and St. Catharines, Ontario, Canada, have elected the following officers for the coming year: President, J. Harvey Williams; vice-president and general manager, A. D. Armitage; second vice-president, Frank W. Trabold; secretary and treasurer, W. A. Watson; controller and assistant treasurer, R. S. Baldwin; and assistant secretary, C. B. Harris. Mr. Armitage is also president of the Whitman & Barnes Mfg. Co., Akron, Ohio, but will be active in the management of J. H. Williams & Co. to which he will devote most of his time.

Defiance Machine Works, Defiance, Ohio, has just celebrated the fiftieth anniversary of its existence. Beginning in 1870 with one small building having 800 square feet of floor space, and with 15 men, the organization has developed until it covers 200,000 square feet of floor space and has 700 employes. From a localized business in woodworking machinery, an organization has been built up for designing and constructing both wood- and metal-working machinery of a great number of types. The company was organized by Peter Kettenring in 1870. His son, William A. Kettenring, was the active head of the organization from 1890 until 1912. Charles Henry Kettenring is now president, and Ransom P. Kettenring, vice-president of the company.

Tool Sales & Engineering Co. has been incorporated in Chicago, Ill., with an office and warehouse at 546 W. Washington Blvd., by T. J. Davis, C. E. Block, and C. B. Cole, to act as a tool distributing company. The concern will serve as direct factory representative for several states in the Middle West, having been appointed agent for the Gardner-Bryan Co., Cleveland, Ohio, manufacturer of taps, dies, and screw plates; the Fast-Feed Drill & Tool Corporation, Toledo, Ohio, manufacturer of high-speed drills, reamers, etc.; and Ibsen & Co., Milwaukee, Wis., manufacturer of gage-block sets. Complete stocks of the lines of these companies will be carried in Chicago to take care of the dealers' and consumers' trade in that territory. T. J. Davis was formerly connected with the Chicago office of the Union Twist Drill Co.; C. E. Block was formerly secretary and treasurer of the McMullen Machinery Co., Grand Rapids, Mich.; and C. B. Cole was previously manager of the Chicago office of the Union Twist Drill Co.